THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 63 Thursday, December 26, 1940 No 1271

PUBLISHED WEEKLY

Subscription Terms (Home and Overseas): 21s. per annum.
All Subscriptions are payable in advance.

THE FOUNDRY TRADE JOURNAL
49, Wellington Street, London, W.C.2.

EMERGENCY ADDRESS
to which all communications should be sent until further notice:—
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Telegraphic Address: "Zacatecas, High Wycombe."
Telephone: HIGH WYCOMBE 1792 (3 lines).

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A Neglected Field

Some years ago, we had a long talk with the late Sir Henry Fowler which centred around the special conditions appertaining to the British railway system. Of that pleasant interview, the outstanding recollections retained in our memory are that, compared with American conditions, for instance, our gradients are much less formidable; the train loads lighter; the speeds higher, and the traffic denser. Climatically, British railways, fog excepted, experience probably less severe operating conditions. There may have been other factors which we have forgotten, but amongst those cited there is nothing revealed capable of damning out of hand the use of chilled-iron wheels for goods wagons.

On the other hand, there are enough reliable data disclosed in Mr. C. C. Drake's article, printed elsewhere in this issue, to justify a re-examination of the situation and, to our mind, a recommencement of practical tests at the first favourable moment. The less progressive railway engineers will no doubt remind us that, after the last war, a foundry was put into commission on the North-West coast specially for the purpose of making chilled-iron wheels, but it had a comparatively short life. To this we retort that if a small concern had undertaken the pioneering of the spun cast-iron pipe, the enterprise would have finished in Carey Street. The resources of the Stanton Ironworks and especially Mr. Fox's initiative, enterprise and determination, built up a system destined to be a great national asset.

For the establishment of a chilled-iron wheel business in the United Kingdom, an effort of a kindred character will have to be made. Our major interest in this work is to attract further tonnage to the foundry industry, as it is obvious that it is liable in the near future to experience a period of nibbling by rival industries concerned with asbestos, cement and plastics.

The position occupied by the "chilled car wheel" industry in America and Canada can best be visualised by the following statements: There are 16,000,000 wheels in service, weighing some 5¼ million tons. These have been made by 48 foundries, which now give a ten-year guarantee, as against a four-year or five-year warranty a few years ago. Such figures denote a large-scale technically progressive industry. It is alive to the value of co-operative research, and the Chilled Car Wheel Association, under the direction of Mr. F. K. Vial, has achieved a leading position amongst kindred associations in America.

The technical advantages of chilled-iron wheels are: (1) they have an exceptionally high coefficient of friction between the wheel and the brake shoe; (2) the life of the brake shoe on chilled-iron treads is an extremely prolonged one, as compared with the results obtained when operating on other metals, and (3) the abrasion between the flange of such wheels and the steel rail is less than between steel and steel. This brings about an appreciable reduction in both train resistance and the wear of the rail and the flange.

There still remains the question of cost, and on this subject we can only presume that the germane factors are liable to operate similarly in America as over here. The complete elimination of machining, except for the central hole in the soft iron of the hub, should make for cheap production. A factor of some importance is the life of the chiller; we investigated this a few years ago in the foundry of Mr. Ropsy at Antwerp, and the relative costs were then of a minor order. It is worth noting at this stage that a chilled-iron wheel foundry has also been successfully operated in France for some years.

Current literature on the subject of "chilled car wheels" usually contains some reference to the hot-blast cupola, which has proved particularly successful and economic. Major contributory factors are the lengthy runs and high outputs. When, as no doubt will be the case, the manufacture of chilled wheels is started in this country, we strongly advocate a not-too-slavish following of the American chemical compositional specification. For some reason yet to be discovered, British irons and steels carry less carbon than American materials to achieve the same results. For the rest of the practice, as established by the Americans, it seems well worth following as closely as possible.

Book Reviews

Remove the Shackles. By A. G. McGregor. Published by Sir Isaac Pitman & Sons, Limited, Parker Street, Kingsway, London, W.C.2. Price 5s. net.

The wealth of literature advocating more or less radical cures or palliatives for the ills of the modern economic machine has been amplified by a contribution entitled "Remove the Shackles," by an eminent American engineer, Mr. A. Grant McGregor, who has many outstanding engineering achievements to his credit, including most of the important modern copper-producing plants in the world and a host of metallurgical units. On the assumption that there is some parallel between physical and economic forces and the principle that recurrent depressions are avoidable only by an expansion and fostering of the demand for and the consumption of manufactured commodities, the author has devoted much speculation and discussion to the present economic morass, the evaluation of which activities and a proposal for a reorientation in economic and particularly wages policy form the subject of this book. The fundamental principle of his thesis, shorn of all niceties and adornments, is that the root cause of the present economic plight of the world, and of the democracies in particular, is the prevalence of unemployment in a world system surfeited with productivity, but apparently incapable of economic adjustment. It is suggested that this deplorable generality of unemployment can be remedied and its re-occurrence prevented by a general increase in the wages level and in prices to what is termed in the book the "prosperity level." Better wages would mean greater consumption, which by the operation of the usual interfunctional economic factors would call for more employment of the unemployed masses, in other words the artificial creation of a contra-vicious spiral. Monetary policy, cast-iron price levels and commodity rationing are palliatives having no attraction for the author, for supply and demand should be, and fundamentally are, the sole controlling factors determining the working of the economic machine. The price regulation question is discussed with regard to steel, for which two prices, one for war purposes and a higher level for civilian demand, are however deemed logical by the author.

On reading the hopeful introduction to the book by Sir Archibald Mitchelson, we had expected that the author's wide experience in engineering would have led him to view the economic problem through other eyes than those of the doctrinaire economist and to have maintained a detachment from economic dogmatism in inspecting the economic machine prior to setting out the overhaul specification. We are disappointed to see the author succumb hook, line and sinker to the ways of thought of some professional economists, in advocating what may be termed a principle of economic monotheism with high wages and the free operation of the "law" of supply and demand as the means and manner of achieving a reasonable efficiency in the economic machine. While we have derived some pleasure and some disappointment from a reading of the book, and we recommend others to devote some study to it themselves, our attitude to the economic machine and the high priests of the "science of economics" suggests that it is incomprehensible that such an imperfect machine as the economic one—the only machine which is entirely man-made and has no counterpart whatever in nature—operating for decades with an inefficiency which would consign any moulding machine to the scrap heap without a single qualm, and moreover exhibiting the most grotesque idiosyncracies, inexplicable and irremediable by the professional economists, is to be converted by such simple adjustments to a reasonable measure of efficiency. We fail to see Mr. McGregor's parallel between economic and physical forces, for the former have been created to satisfy man's illusions, and the latter are fortunately creations or phenomena entirely independent of man's intervention. The machine of economics has gained the complete mastery of man, it has run amok, and we fear that much tinkering and adjustment, and even the design of new parts as yet undreamt of, are necessary before it will begin to show even the earliest signs of tractability and efficiency. We are passing through the economic Dark Ages, and such simple remedies as Mr. McGregor proposes do not seem to provide a drastic enough prescription.

Bibliography of Spectrochemical Analysis. Compiled by D. M. Smith, B.Sc., D.I.C. Second edition. Published by the British Non-Ferrous Metals Research Association, Euston Street, London, N.W.1. Price 3s., post free.

Mr. Smith's book, "Metallurgical Analysis by the Spectrograph," was published in 1933, and included a list of 114 references. This list, brought up to March, 1935, was then issued as a separate publication, under the title "Bibliography of Literature on Spectrum Analysis." In the present second edition of the bibliography, the references have been brought up to August, 1940, and now number 510; to conform with current terminology, the title has been changed to "Bibliography of Spectrochemical Analysis." Short explanatory notes are given with most of the references, and an author index is provided. The grouping of the references in sections obviates the necessity for a subject index. There have been some alterations to the arrangement of the matter, possibly the most important of which is the inclusion of a new section on "Applications of the Microphotometer," a subject of particular importance at the present time. As before, references are given under the headings of the individual basis metals (with cross-references) so that the reader may quickly find all the published information dealing with his particular field of interest. The section headings are:—Books of Reference; Wavelength Tables; General; Apparatus; Technique; Logarithmic Sector Method; Applications of the Microphotometer; Quantitative Interpretation of Spectra; Analysis of Metals and Alloys (including Aluminium, Copper, Lead, Magnesium, Nickel, Tin, Zinc, Iron and Steel, etc.).

Manganese Supplies in U.S.A.

MR. R. C. ALLEN, of the Advisory Commission to the U.S. Council of National Defence, states in a recent issue of "Metal Progress" that the United States is not facing an immediate emergency so far as concerns supplies of manganese. At the present rate of consumption there is approximately 16 months' supply in the country, and imports are coming in at about the current rate of consumption. Russia is cut off, but sources in India, Africa, Cuba, South America and the Philippine Islands are available and are being utilised to the extent shipping is available. Definite plans are under way for supplementing imports through domestic production of ore suitable for the manufacture of ferro-manganese. In August last a contract was signed with the Anaconda Copper Mining Company for the delivery of 80,000 tons of manganese concentrates per year from proven ore reserves in the Butte mines. A relatively small tonnage of high-grade manganese ore is available from domestic deposits without concentration. However, it will take some time to plan for production and to get production under way in the several districts in the country containing low-grade deposits of considerable magnitude.

Random Shots

Among the many greetings cards which friends have managed to send out this Christmas, in spite of wartime restrictions, is one from Mr. John Shaw, which would certainly take the first prize in an originality competition. Those who were lucky enough to receive this card could spend an interesting ten minutes discovering its many intriguing good wishes for the coming year. It takes the form of a *facsimile* of a ration book, complete with coupons on the inner page, from which the recipient can cut off for himself from time to time a ration of good cheer, sunny hours, happy times and the like.

* * *

Then there is Mr. Barrington Hooper's greeting card in the form of a moonlight calendar. Although this has been produced before by Mr. Hooper himself, the idea is obviously of such practical value that its repetition is amply justified. Last winter one looked upon the moonlight nights as an opportunity to go gallivanting. This winter, alas, one does not go gallivanting, but looks askance at a moonlight night, rather in the same way as the Irish country folk do, as the time when one can expect leprechauns, banshees and other eerie things to be abroad (in the air).

* * *

The menu contrived by an enterprising club chef for the luncheon enjoyed by the London Branch of the Institute of British Foundrymen last Saturday provides a delicious *bêtise* of culinary French. It begins simply enough with *Crême Portugaise, Poulet Polonaise, Haricots verts persilé,* and *Pommes châteaux.* So far, so good. Then follows *Pouding de Noël,* and there are vague protests that such a British institution should be so gallicised, but the *pièce de résistance* has yet to appear. The members look at one another and whisper "What the blazes is coming next?" From among the murmurings at last one hears "Let's ask Delport," "Let's ask Fassotte." But neither of these gourmets of happier times can throw any light on the matter. Excitement runs high, and everyone saves a little space for the mysterious titbits to follow. At last they appear, and who would guess what they are, these *Feuillantines Britannia*? . . . nothing but the homely mince pie! The chef has had his little joke, after all.

* * *

The hastily hand-chalked newspaper poster is becoming a regular feature in the London streets, and they provide yet another outlet for Cockney humour, thereby showing that that commodity is not necessarily a monopoly of the 'bus conductor. On his way home "Marksman" passes a particularly cheery newspaper seller, whose posters are always guaranteed to raise a smile. Last week his originality showed itself in two examples. "'Okey pokey men retreat on a forty-mile front," was followed the next day by: "Musso can't climb the greecy pole. Poor old Musso!"

"MARKSMAN."

Notes from the Branches

London—Between twenty and thirty members of the London Branch of the Institute of British Foundrymen met last Saturday at the Constitutional Club, Northumberland Avenue, London, for an informal Christmas luncheon. It was presided over by Mr. Barrington Hooper, C.B.E., the Branch-President. The only toasts submitted, other than that of "The King," were of a personal character, but one from the chairman included a string of witty epigrams from his collection, which we hope to print in the near future. Mr. Hooper and Mr. Lockwood were warmly thanked for the efforts they had made to ensure the success of the gathering.

Manufacture of Chilled-Iron Car Wheels*

By C. C. DRAKE (Superintendent, Griffin Wheel Company, Denver, Colorado)

There are approximately 16,000,000 wheels in railway service under about two-million goods wagons and engine tenders, carrying well over 80 per cent. of all goods tonnage in the U.S.A. on chilled-iron wheels. In addition to this, there is an important tonnage of chilled-iron wheels and castings in industrial use.

Constant increases in loads, speeds and distances travelled per year have made it necessary for the chilled-wheel industry continually to improve its processes in order to keep up with the ever-growing demands for greater wear, strength and heat-resistance properties. Loads carried by these wheels have increased 300 to 400 per cent., and average speeds have practically doubled in long-haul service since 1912. In industrial wheels, the trend towards expensive bearings to save friction losses has made evident the economic necessity of making and applying only wheels that have the strength and wearing qualities to justify this considerable increase in initial cost of equipment.

High-quality cast iron is produced in an ordinary foundry cupola furnace by a carefully controlled technique developed through many years of experience and much research, especially the latter during recent years.

Range of Sizes

The metal is melted within a very narrow range of chemical composition and temperature. It is poured in special box equipment in which the body, *i.e.*, the hub and plate of the wheel, is solidified in contact with sand, while the tread and wearing portion of the flange are solidified in a cast-iron ring called a "chiller." These chillers are machined to exact circumference and contour, and, while they are used but once a day, they form and "chill" several hundred wheels each on the average. They are about $\frac{9}{16}$ in. larger in diameter than the standard 33-in. diameter of a railway-wagon wheel. The "shrinkage" ($\frac{1}{64}$ in. to 1 in.) of the metal, of course, accounts for the difference between chiller diameter and wheel diameter.

The standard weights of chilled-iron wheels are 650, 700, 750 and 850 lbs. for 30-, 40-, 50- and 70-ton goods wagons respectively.

Annealing and Machining

The chilled wheels are taken out of the moulds in from 35 to 45 min. after the metal is poured, and are placed immediately in insulated receptacles for necessary annealing. These are called annealing pits. After a minimum of three days in the annealing pits they are removed, permitted to cool to room temperature, and then sand-blasted, inspected, tested, and are finally ready for despatch to railway shops or to be pressed on axles in the works machine shops.

The only machining necessary on these wheels is the boring of the hubs for pressing on to the steel axle. In this boring operation the wheels are usually bored 0.006 in. to 0.009 in. smaller than the wheel seat on the axle, and the wheels are pressed on the axle seats by a hydraulic press at from 40 to 75 tons, depending upon the size of axle and weight of wheel. The wheels as cast in the chillers are not despatched if more than 0.031 in. out of round.

Testing Conditions

The test wheels from each heat, selected according to indications given by careful and extensive records taken of all melting, treating, pouring, shaking-out and annealing processes, are subjected to two different types of destructive tests. These are an impact test, in which a 250-lb. weight is dropped from varying heights with varying numbers of blows, according to weight of wheel tested, and the other is called a thermal test, and is made to simulate the stresses developed by heating the tread under excessive brake application. In the latter test molten iron is poured into a channel around the tread of the wheel, causing rapid heat expansion of the tread against resistance of the plate or body of the wheel. If any weakness is revealed by these tests, the testing is continued until all doubtful product is eliminated.

The effect of chilling the tread section of the casting is to hold all the carbon in a combined state as iron carbide, accomplished by the rapid cooling rate, while the body of the wheel, which solidifies slowly, has most of the carbon set free in the form of graphite. This results in an easily machinable hub, having a Brinell hardness of around 160 to 170 and a strong tough plate material with high resistance to transmission of vibrations or damping capacity. Combined with these qualities is a tread with Brinell hardness around 420 to 440, with unexcelled bearing value, carrying the heaviest loads without indication of cold rolling or flowing of metal at the tread surface.

Increased Coefficient of Friction

Due to the physical properties of this chilled tread metal, the coefficient of friction between wheel and brake shoe is 25 per cent. greater than that developed on other types of wheels under the same pressures. Also, the durability of the brake shoes on chilled-iron treads is 25 to 100 per cent. greater than on other metal, the variation depending on the type of brake shoe used.

The abrasion between a chilled-iron flange and a steel rail is much less than that of a steel flange against a steel rail, and this means appreciable reduction in both train resistance and wear of rail and flange. These are items of great economic importance.

During the past ten years vast improvements have been made in physical properties of cast iron in general, and the chilled-iron wheel industry has carried on extensive research in its own and other laboratories, resulting in important improvements in strength and wearing values, as well as manufacturing methods. Some of these latter may be of interest.

Recent Improvements

The principal manufacturing improvements developed in recent years are as follow:—

(1) Better melting control through cupola gas analysis, automatic air-volume control, desulphurising, standardisation of chill test blocks, development of blast pre-heating, more uniform charging, and determination and development of optimum melting and pouring temperatures.

(2) A much improved method of controlling chill depth has recently been developed, and is now being extended to all plants in the industry. This will ensure an adequate depth of chill in all wheels with very little likelihood of having excessive chill depth in any wheels. The matter of definitely controlling chill on all wheels within the narrow limitations required has long been a problem in the chilled-wheel industry.

(3) Better strength control through standardisation of handling and annealing the wheels from time of pouring till they are cooled to atmospheric temperatures.

There have been many additional improvements in recent years, such as foundry sand control, mechanical moulding, mechanical charging, and Association inspection of the product, independent of individual plant control.

Cupola Practice

In operating a foundry cupola, the percentage of CO_2 above the melting zone is a direct indication of the type, or stage, of combustion prevailing. By sampling these gases of combustion and passing them through a gas analyser or carbon-dioxide determinator, the operator can make changes in the volume of blast entering the furnace as the CO_2 rises above or sinks below the range of 12 to 14 per cent., in which, experience has shown, the best results are obtained in a hot-blast cupola. A gas analyser records the percentage of CO_2 every two minutes on a chart, and when an automatic volume control is used in connection with the gas analyser, the volume of air is automatically increased or decreased as may be required.

If the CO_2 percentage is shown to be under 12 per cent., it is an indication that there is an inadequate supply of oxygen for the amount of coke being used. The coke charges are calculated to be sufficient to supply the heat necessary for melting a given charge of metal at the required temperature and with sufficient surplus coke to prevent over-oxidation of the essential elements—silicon and manganese. These elements must be held in a very narrow range because of their balancing effect on graphitisation. In case the CO_2 analysis is recorded above 14 per cent. in a hot-blast cupola, the operator would normally reduce the volume of air, as it would indicate too high a stage or type of combustion and a consequent probability of excess oxidation of essential elements. The test-pieces would soon confirm the oxidation indicated by the gas analyser by showing high chill depth and sparse, open mottle of graphite behind the chill.

In a hot-blast cupola, the gases are withdrawn by a water injector from the upper gas outlets and passed through filters to remove soot and fume. The gas is then passed through a CO_2 gas analyser such as the Hayes automatic CO_2 analyser, and the CO_2 percentage is recorded on a circular chart.

Automatic Carbon-Dioxide Compensator

To obviate the necessity of manual control of the blast, depending on the presence and alertness of the operator, there has been developed by the Chilled Car Wheel Association's research engineer, Mr. F. K. Vial, an automatic CO_2 compensator for cupola control. A Paper by Mr. Vial descriptive of this device was awarded first prize in an instrumentation contest sponsored by the Industrial Instruments Section of Scientific Apparatus Makers of America in 1938.

The mechanism electrically interlocks the carbon-dioxide recorder with an air-volume controller and automatically regulates the stage of combustion by increasing or decreasing the air volume according to the decrease or increase of CO_2 in the stack gases.

The stage or type of combustion mentioned as optimum for hot-blast cupola operation may be questioned as being too low for efficiency. However, when the factor of excess oxidation of silicon and manganese is considered, as compared with the cost of excess coke consumption in this stage of combustion, it will be found that the 12 to 14 per cent. CO_2 analysis is most economical.

More important than this, however, in melting chilled-wheel iron, is the necessity of uniformity in composition and structure. The comparatively strong oxidising effect of high CO_2 percentages going with the greater efficiency of combustion means heavy and erratic losses of essential elements, including iron, whereas carbon monoxide is a powerful reducing gas.

The installation of this gas analyser, together with an air-volume or air-weight control, reduces erratic results from over- or under-oxidised elements in eliminating much of the

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* Extracted from "The Mines Magazine," September, 1940.

human element regarding combustion conditions in the furnace. The principle is, of course, not new, but the application to cupola furnace control is a comparatively recent development. However, gas analysers have not yet been adopted as a standard piece of equipment throughout the industry because of the excellent and uniform results obtained by many experienced cupola operators.

Griffin Air Pre-heater

Another improvement, the Griffin hot-blast air pre-heater, takes advantage of the carbon monoxide content in the stack gases. This was the first practical application to cupola furnaces of well-known and long-used recuperative or regenerative methods of preheating the air blast by utilising the products of incomplete combustion remaining in the stack gases at the charging doors.

The stack gases are drawn through gas outlets a few feet below the charging doors by suction induced by an exhaust fan. The combustion of the carbon monoxide is completed in a large refractory-lined chamber by the introduction of a small volume of air, bled from the cold blast supply. The temperature developed in this refractory-lined combustion chamber is from 870 to 980 deg. C.

In the more generally used recuperative-type blast heater, these gases are passed through one or more banks of heavy cast-iron tubes and then exhausted to the atmosphere. Meanwhile, the cold blast, instead of entering the cupola direct from its source, is baffled around the pre-heated cast-iron tubes and enters the wind box at temperatures ranging from 200 deg. C. up to twice that temperature, depending upon the type of installation and operating requirements. There is very little maintenance expense to these pre-heaters.

Advantages of Hot Blast

Some of the advantages of using pre-heated blast in the cupola furnace are as follow:—A saving of 25 to 30 per cent., or more, in coke consumption; higher temperatures in the melting zone and increased fluidity of the iron if desired for pouring thin sections; higher melting rate per hour; greater uniformity of operation and therefore better control; less limestone and, of course, less air required for the reduced coke ratio. These advantages result also in lower power and labour costs.

Sulphur Reduction

Another timely means of improving the composition and structure of chilled-wheel iron was brought about by developing a chemical reaction to reduce the sulphur content. Some years ago the ever-increasing sulphur content in remelting old wheels and other cast-iron scrap was a matter of growing concern. The use of sodium carbonate or fused soda ash was introduced by the chilled-wheel industry and, of course, solved the problem of controlling sulphur content, as well as finding a much wider field of usefulness in the iron and steel industries.

Graphite and Tellurium Ladle Additions

Chilled-wheel service requires that the chill or massive cementite beneath the tread surface be of sufficient depth to ensure maximum wear or mileage before the chilled metal is worn away, and also that the chill is not deep enough to weaken the flange or rim to a point where breakage is likely to occur. In the past this control of chill has been accomplished by additions of silicon or chromium, as may be required, to the pouring ladles. The reaction of these elements, while definitely softening or hardening the metal beneath the chilling surface, was to produce a chilled area containing a rather wide distribution of small graphitic specks in the white iron and a dispersion of iron carbides in the grey iron. This condition created a very narrow margin between a wheel that had too little chill and one that had too much. The new technique employs the simultaneous use of both a graphitising and a stabilising agent, and results in a much more clearly defined chill area, having practically no graphite in the white metal and a minimum of iron carbides in the grey metal. This is accomplished by the introduction of very small quantities of graphite and tellurium in correct proportion and balance into each ladle before the metal is poured.

This new method of chill control will assure the industry of definite depth of clear chill metal on the tread surface, and a softer, stronger metal to support the flange.

Stripping Time and Temperature Control

The improvements so far discussed have been in melting and composition control. Better determination and standardisation of pouring temperatures have had an important part in improving the control of chill, both as to strength and wearing properties. They have also improved the structural properties of the body of the wheel. The uniformity which has been enforced in timing the castings between pouring, shaking-out and soaking has also had a marked effect in improving these properties.

Heat-Treatment

One of the greatest improvements in many years, however, is the development of an ideal cooling curve for the chilled-iron wheel and the evolution of a type of annealing pit that would stand up under chilled-wheel soaking-pit conditions and give a uniform rate of heat loss that would conform to the cooling curve established. In using the term "annealing" the author does not imply, in this industry, the use of supplementary heating followed by cooling, although some plants have been, and now are, equipped with oil-fired pits that would accomplish this if desired.

The best results for this type of chilled casting have been obtained from placing the wheel, immediately after it is removed from the mould at maximum safe temperatures, in an insulated receptacle which will permit a uniform heat loss of 4 to 5 deg. per hr. The type of soaking pit now generally used is lined with 6 in. of diatomaceous earth bonded with asbestos fibre. These pits are 16 ft. in depth and designed to hold 24 standard railway car wheels. They are sealed, immediately after filling, by a cover equally well insulated. The minimum cooling cycle is three days.

At the time of soaking, the temperature throughout the body of a car wheel ranges from 760 deg. C. at the chilled tread surface to not much below the temperature of solidification in the hub section. The objects of this annealing, or controlled cooling, are:—(1) To prevent the formation of cooling stresses; and (2) refinement of structure both in the chilled and the grey iron sections of the wheel.

The pouring temperatures and the time the castings are left in the mould have a decided influence in fixing the initial temperatures at which the wheels are "pitted," and the temperatures raise or lower the cooling curve accordingly. The weights of wheels being cast, ranging from 650 to 850 lbs. each, are also an important factor. The cooling curve, therefore, is a function of the pouring temperature, shake-out temperature, and the total weight of metal pitted.

When a chilled wheel cools too rapidly, there are all kinds of stresses produced. There is radial stress that tends to pull the plate apart, and transverse stress that tends to split the tread in the centre. These stresses are relieved by equalising the temperature well above the critical range and limiting the subsequent cooling rate.

The effect of this exactly controlled cooling gradient is to equalise the temperature throughout the chilled wheel above the critical range and prevent the formation of potential internal stresses while structural transformations are being completed. This is in the range of 790 to 675 deg. C. In this particular, the structure of the tread is modified to give a much greater comparative toughness because of changes in one of the forms of the iron carbide.

The most important function, so far as refinement of chill structure is concerned, is the complete spheroidisation of the pearlite in the chill. There is, of course, no graphitisation of the massive cementite, which constitutes over half of the chilled structure, at these temperatures and cooling rates.

Metallurgical Considerations

The average chemical analysis of a chilled wheel is:—Total carbon, 3.50; silicon, 0.52; manganese, 0.50; sulphur, 0.13; and phosphorus, 0.28 per cent. The combined carbon of the hub and plate material is quite consistently between 0.60 and 0.70 per cent. after annealing. This composition results in a hub and plate metal which is free from primary or excess carbide, and consists of a uniform distribution of lamellar pearlite. This combination develops a hub material with excellent machinability, and a plate material that is strong and sufficiently resilient to have great impact strength.

The carbon in the tread material, 3.50 per cent., is practically all in the combined form. At a depth of about ½ in. in from the tread surface the combined carbon is decreased to about 3.00 per cent. As the graphite mottle increases below the chill, the combined carbon further decreases until the massive cementite disappears entirely, and the structure progressively becomes softer until it blends with the soft grey iron of the plate material.

All of the fundamental valuable properties of the chilled wheel, *viz.*, the machinable hub, the strong, resilient plate, and the extremely hard tread metal are being constantly improved by modern technical developments. Other outstanding features are its comparatively low cost, its tread resistance to plastic deformation, its plate resistance to transmission of vibrations, its remarkable economy in connection with rail wear, brake-shoe wear, train resistance, and high coefficient of friction in brake application. These are only part of the economic properties attributable to the chilled car wheel.

The exact circumference of the wheel tread is an indication of the hardness and depth of chill in the metal. The tread section is cast in an accurately machined chiller and the composition and structure of the metal determine the amount of shrinkage above or below normal that is indicated in the exact circumference. The improvements in control effected in recent years have reduced the variations in shrinkage exceeding ½ in. above or below the normal circumference from 30 per cent. in 1935 to 10 per cent. in 1939 in all plants of one manufacturer.

A Ten-Year Guarantee

These improvements in process have enabled the fifteen individual manufacturers operating a total of 48 foundries in the United States and Canada to increase the time guarantee on railway wheels from the four-year to five-year guarantee in effect several years ago, to a seven-year guarantee of service two years ago, and now to ten years' service, which is just being placed in effect. These are concrete evidences of increased strength and wear properties resulting from improved processes.

Constant further research is being carried on in the Wheel Association and other research laboratories. The industry has great hopes that these research programmes will develop still greater improvements.

The Randupson Process

OPERATING DETAILS DISCUSSED

The East Midlands Branch of the Institute of British Foundrymen held the November meeting in Derby, and, in the absence of Mr. S. E. Dawson (President of the Branch), who was recuperating from an illness, Mr. A. E. Peace (a Past-President) presided. The meeting was devoted to the presentation and discussion of the Paper entitled "The Randupson Process of Cement Moulding,"* by Mr. F. W. Rowe, M.Sc.

MR. J. C. HALLAMORE, who opened the discussion, said Mr. Rowe had frequently referred to the cost, and he asked if the method was cheaper than ordinary moulding. It had been stated that the moulding was very much cheaper, but that other costs were higher, and he would like to know how that balanced out. The drying period seemed to occupy rather a long time. Was it possible to reduce that at all? They were still using ordinary sand cores for intricate work, and he asked if it was possible to combine the two methods.

Relative Costs

MR. ROWE said the point of the process was to get the total costs down, and while their moulding costs were very much reduced, the increased sand cost robbed it of some part of the advantage. For a job where cement moulding was suitable, he would say that the total combined sand and moulding cost worked out at an average of about a third cheaper. It was possible to hasten the drying a little, but it was not advisable to have a temperature above 80 deg. F. If the drying were done too quickly, it caused cracking through expansion.

Quite frequently oil-sand cores were used in cement sand moulds. It had not been found possible to increase the green sand strength of cement sand by any other additions which would give a satisfactory job. Almost anything that was done either seemed to increase the drying time or reduce the permeability.

Sand Losses

MR. F. DUNLEAVY asked what method was used for treating the sand that had been left over, and what would be the effect of leaving the facings in the sand over a period of days during ramming. There was a good deal on that point that he did not understand. One query was, how did they locate the joints? What method was used for repairing the mould?

Regarding the loss in cement of 6 to 10 per cent., he asked if there were any other losses apart from the cement. What percentage of silt was there in this, and how was it removed?

Incidence of High Crushing Strength

MR. ROWE said the heavy loam jobs were the ones where the cement moulding process, properly handled, should shine, and did shine. He had seen a very large amount of condenser work done in cement sand, and the cement sand was usually worked in a pit to save material. That was, it was struck up in a deep pit in the floor, and gradually built up, and the core was separately constructed. No difficulty was experienced providing the high crushing strength of the sand was remembered. In that respect, Mr. Rowe described the action of heat on a cement mould, and the reason that with so high a crushing strength they did not get trouble through cracking of the mould. The layers of sand adjacent to the hot metal were dehydrated and lost strength.

With regard to the location of joints on these moulds, any method which appealed to them, as foundrymen, could be used. Most of their work was located by buttons and sockets on both halves of the pattern plates, which seemed to be the most popular method. Drawbacks were one of the easiest propositions to deal with in cement moulding. Far less careful ramming was needed than with a normal drawback, because within six hours at the most it was strong enough to lift away, but not strong enough to cast. In twenty-four hours, any of the biggest moulds, weighing six or eight tons, were strong enough to lift by the crane.

Ribs were made by the usual method. They were left loose and drawn out after the main body of the pattern was drawn away. No serious difficulty was experienced with patching. Ordinary patching was done before the mould set.

With regard to the cost of the sand, Mr. Rowe said every bit of backing or facing sand had to have 6 to 10 per cent. of cement in it every time it was used, which, of course, accounted for the big increase in cost. The usual silt extraction was from 10 to 21 per cent. on the old moulds.

Use of Moulding Machines

MR. B. GALE recalled that Mr. Rowe had made claims for the Randupson process that the extra cost of sand and preparation was offset by the great saving in the moulding time. One could appreciate that, on large castings moulded by hand, a considerable saving would be made on the ramming time due to the "flowability" of the cement sand as compared with ordinary moulding sands, but he (Mr. Gale) wondered how the time would compare with the ramming of similar moulds made on large jolt-ram machines or on Sandslinger machines. Could moulds made in cement sand be rammed by the jolt or Sandslinger machines?

Crane Service Reduced

MR. ROWE, referring to a big jolting machine, said the saving was not quite as dramatic as with an ordinary hand-rammed mould, but of course jolting machines were rather expensive. Whilst they had quite a large number of moulding machines, there again, probably their biggest saving was not so much on moulding as on box parts, as they had none of these at all. A rough wooden box was built up each time, and could be made just the right size.

There were not many people who could afford a jolt and turnover machine for, say, a 6-ft. by 4-ft. box part. If they had one, very often they found their best jobs would not go on it. Then again, there was the amount of crane lifts needed on any jolting machine, using ordinary cast-iron box parts. The cement-moulding process had that big advantage over ordinary foundry methods; far fewer crane lifts were needed.

Sagging of Moulds

MR. W. C. MARSHALL said that Mr. Rowe had emphasised the poor green strength of cement sand and, combining this statement with the maximum figure of 7 in. given for sand thickness on large moulds, asked if any difficulty was experienced with moulds sagging. Was the thickness increased in the top of the mould to resist metal pressure? If not, he presumed that the amount of reinforcement was much greater than necessary with large green-sand work.

In connection with the repeated use of old or backing sand, was there a tendency for the sand to receive a coating of cement which might affect its properties?

Finally, was any chill effect experienced due to the use of cement sand, particularly with grey iron? Although it was appreciated that mould thicknesses were small, it was possible that the castings were slightly affected in this direction.

Chill Effect

MR. ROWE said the cement sand had very little green strength, and care had to be taken with the big moulds that they did not sag, until they had had a chance of hardening. They worked moulds up to about 4 ft. square on a board, which had to be strongly constructed, but over that limit they liked to turn the mould out on to a flat steel plate.

With regard to the reconditioning of sand, there was no pick-up of cement. The backing sand, after being crushed and reconditioned, was equivalent to a new sand with about 1 per cent. of cement added. They could go on using a reconditioned sand almost indefinitely, for the dead cement was rubbed off in screening.

There was a slight chill effect, due to cement moulds, which was equal to about 0.15 per cent. silicon in a grey iron. One obtained the same fracture from casting in a cement mould metal containing 2 per cent. silicon, as casting in ordinary moulds with 1.8 per cent. silicon.

Cement Losses

MR. DUNLEAVY asked if there was any definite percentage of loss of cement. He could visualise the process working successfully in a new foundry, he said, but it would be very difficult to work it in an old foundry.

MR. ROWE said they started off with a new sand and added to it, say, 8 per cent. of cement and 6 per cent. of water. Once that sand had been used the cement was lost, but after sieving the sand to remove all dead cement it was ready to start with again.

Sand Adhesion to Pattern

MR. E. HOLLAND asked what would be done with a complicated joint, and how soon could a pattern be taken away from a mould? Was there any adhesion of the cement to the pattern, or had the pattern to be treated before use?

Cellulose-Painted Patterns

MR. ROWE said on a very complicated joint it was not possible to ram straight on. The best method was to make the bottom half one day, and the next day make the top half. The main thing about a pattern was that it had to be taken out quickly, as there was a slight expansion of the mould. To prevent adhesion of cement, they usually oiled the patterns all over with paraffin before using, and they used a cellulose paint on patterns, and got very clean lifts.

Nature of Cement

MR. A. E. PEACE was interested to know whether ordinary cement was used. or whether it had a special lime content. He also wondered if a fineness was specified. It occurred to him that temperature must have a profound effect on the setting time. Was the time seriously affected in hot weather in the summer, or in frosty weather in winter, and did similar differences in temperature have an effect on the milling or mixing?

He presumed there was a shrinkage of the mould on setting. and he would like to know if it was very considerable. A very coarse silica sand, presumably, would be used to get the maximum permeability; was that sand gradually broken down when it was crushed for re-use?

MR. ROWE said the ordinary Portland cement was found to be better than the very finely ground cement. As Mr. Peace had remarked, temperature had a profound effect on setting time, the setting practically ceasing at freezing

(*Continued on page* 418.)

* Published in the JOURNAL for June 23, 1938, pp. 520-6.

Boards for Split Patterns

By JAS. TIMBRELL

Boards to take split wood patterns for floor or machine moulding production have many useful advantages. Patterns can be easily set out to register, and, if fastened with wood screws, will give and retain a good standard of accuracy. The lightness in handling facilitates quick and easy changing, either for machine or "double-handed" floor work.

The sketches reproduced are largely self explanatory, and are compiled from an 18-in. by 12-in. set. Measurements and details may be varied to suit other sizes of moulding boxes and methods of production. Loose pins or pin and hole part boxes can be used as required.

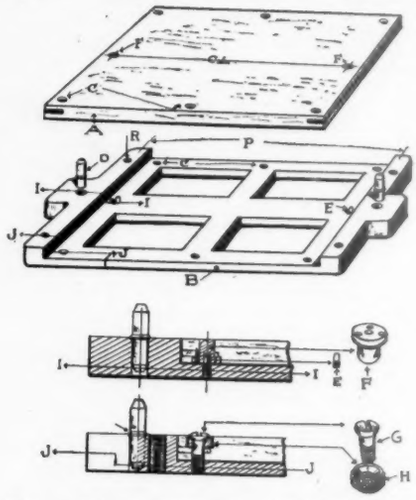

FIG. 1 (UPPER SKETCHES).—CAST-IRON SUB-FRAME AND PATTERN BOARD.

FIG. 2 (LOWER SKETCHES).—HOLDING ARRANGEMENTS.

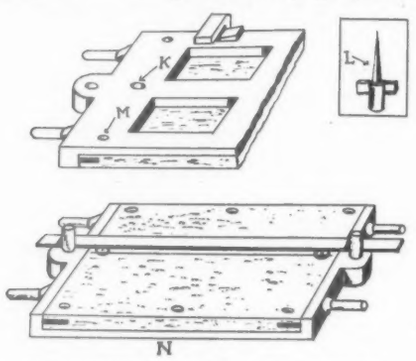

FIG. 3 (UPPER).—HALF OF DRILLING JIG.
FIG. 4 (LOWER).—DRILLING AND CENTRING JIG.

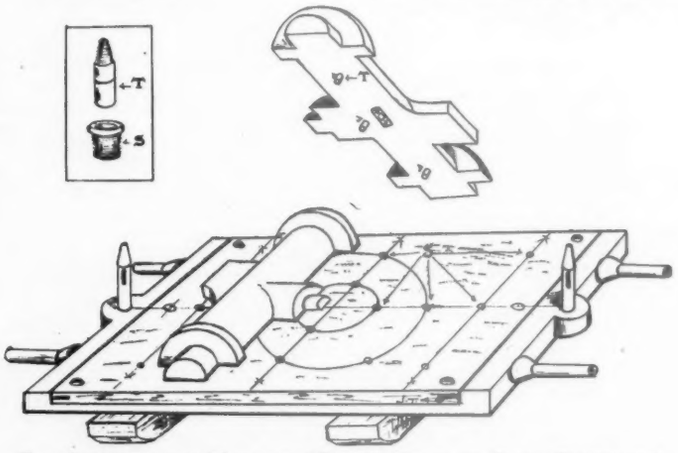

FIG. 5.—REVERSIBLE UNIT FOR "DOUBLE-HANDED" FLOOR PRODUCTION.

Fig. 1 shows a cast-iron sub-frame attached by ½-in. screws in R to the moulding-machine table. Pattern board A is registered in position by fixed ¾-in. dowel pins E, which engage with the shouldered and drilled bosses F fastened permanently in the pattern board. The method of securing pattern board A to the frame is by six milled-edged and countersunk inserts pressed into the board to take the screws G, Fig. 2.

A sectional view taken through the moulding-box pin-hole, pattern board, shouldered boss and dowel pin is shown by the top item I, I, Fig. 2. The lower sketch in Fig. 2 shows a milled insert, the pattern-board holding screw and one of the six screwed holes for holding the frame to the moulding-machine table. Frame N, Fig. 4, is the drilling and centring jig, for the preparation of the pattern boards, and is a replica in the main items of the frame B. Holes K are enlarged in the jig to take a patternmaker's drill, the diameter of F.

Holes M are drilled to a clearance diameter of the screws G; inset is a wood-cutting tool to shape the recesses to take shouldered bosses F. A similar tool is made to shape the recesses to take the inserts H.

The shouldered bosses may be turned from a length of cast iron, and the ¾-in. dowel pin hole drilled ½ in. deep true to the diameter. The length of these should be the exact width of the pattern board and finish flush with the joint face. So fixed, they will allow a permanent centre "pop" parallel to the box pin centres (Fig. 4) for all foundational lines prior to setting any split patterns out.

Fig. 3 shows half the drilling jig and the method of securing the pattern board for drilling. Fig. 5 shows a further development rigged up as a reversible unit for "double-handed" floor production.

A master board is prepared with predetermined positional dowel sockets, patterns are equally set out, and once set out and dowelled may be re-issued as often as required, and will reoccupy the original set out. This system allows patterns to be worked "loose," where absence of "taper" or other stripping difficulties are to be overcome. Patterns can be put back on

(*Continued in next column.*)

(*Continued from previous column.*)

the board with an assurance of register for each ram-up.

The length of the pattern boards should be designed to come just inside the moulding space area P. The frame B should take the moulding box joint face. The jig, frame and any additional ones should preferably be drilled from the "master." If loose pins are used, D, the pin holes should be countersunk to take the small collar, and should be a push-fit into the frame with reasonable clearance for the moulding-box holes. Where pin and hole part moulding boxes are called for, the holes in the frame should be proofed against excessive wear by hardened bushes.

High Nickel-Chromium Castings

Alloys employed by the foundry industry for service in the temperature range between 650 and 1,150 deg. C. are dealt with by MR. JOSEPH B. SHELBY (manager of the foundry department of the Driver-Harris Company) in "Metal Progress." The three predominating analyses are given by the author as:—(1) 60 per cent. Ni and 13 per cent. Cr; (2) 35 per cent. Ni and 15 per cent. Cr; and (3) 12 per cent. Ni and 26 per cent. Cr. In all of these the balance is iron plus the important ingredients of carbon, silicon, manganese and minor alloy additions. While this variety would seem to provide a convenience in the foundry, even these representative analyses must be varied in minor ingredients to be suitable for particular applications, and it is this selection which imposes so much responsibility on the designer and foundryman.

Gas carburising has clearly shown itself to be one of the most difficult applications for alloys to withstand, and most frequently, the writer points out, this is complicated by the supplementary operation of an oil quench. The mechanism of failure of alloy parts in gas carburising by erosion or corrosion is not yet fully understood, but representative foundries have learned to control it, and a great improvement in life under these circumstances is assured. The most severe service arises where the alloy is completely surrounded by the gas, as is the case when baskets, trays or fixtures are used in muffles and retorts.

Of great importance now to the carburising, nitriding and heat-treating fields is the economical loading of a furnace to get the greatest production. The full co-operation of all concerned has frequently resulted in doubling the load in a given furnace. This accomplishment has resulted from interesting designs requiring castings, rod, tube, sheet and welding of high alloys.

Since the inception of these alloys, their uses and limitations have been studied and improved, and to-day they offer means of doing things faster, thus being a contribution towards increased production of mechanisms unequalled by any other single factor. They make to-day's furnaces possible. Even with this tremendous importance attached to their use, the true worth of these alloys is not always developed. The "heat-hour" cost of use in service is the only true denominator and not the first cost or purchase price. When this fact is studied, it leads to real economy. "Nominal analysis," usually designating only the nickel and chromium in the alloy, is not indicative unless melting and moulding practices of the competing foundries are identical. Where sulphurous gases are not present, as is the case in the large majority of high-temperature applications, a study of heat-hour costs will demonstrate the economy of the higher nickel alloys.

The Acid Bessemer Process of 1940

By H. W. GRAHAM

(*Continued from page* 395.)

Investment Costs

Once the steel industry had reached a reasonably established state, investment costs began to apply a considerable influence on the proportion of steel made by the Bessemer and open-hearth processes. Toward and even after the turn of the century, the rapidly growing industrialism of the United States demanded increased steelmaking capacity. Financiers naturally were attracted by the fact that, since scrap had become a widely available and usually rather cheap article of commerce, an open-hearth plant using 60 per cent. scrap could be built with only 40 per cent. of the investment for blast furnaces as compared to the cost of ironmaking facilities for a Bessemer plant using practically 100 per cent. pig-iron. This fact undoubtedly played a part in the rapidly shifting balance of open-hearth steel most noticeable in the period of 1900 to 1910.

Product Losses

Apart from economic factors operating against the Bessemer process, the method sustained serious losses in its products between 1900 and 1940 for a combination of metallurgical and mechanical reasons.

From the standpoint of product application, the Bessemer process first lost rails because of a poor reputation for dependability; and on much the same count it not long thereafter ceased to be used for heavy structural sections. The large-scale development of seamless pipe that occurred in the period of 1910 to 1930 went almost entirely into the open-hearth bracket, doing little actually to decrease the Bessemer tonnage but still greatly swelling the balance in favour of the open-hearth process. Almost the same statement, with the same result, can be made concerning the expansion of the manufacture of flat-rolled steel from 1920 to 1940; but the development of the continuous strip mill did greatly decrease Bessemer tonnage in that it took over tinplate, which had included much Bessemer on the old hot mills. The steel plants that developed the continuous mill had, it so happened, little or no Bessemer capacity and were not interested in developing its application to the continuous rolling method. Latterly some Bessemer is being cold-rolled into tinplate, but the matter moves slowly.

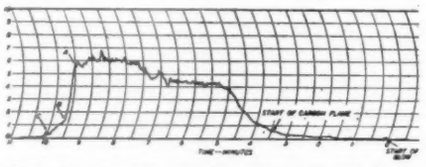

FIG. 1.—RECORD OF LUMINOUS ENERGY OF A REPRESENTATIVE BESSEMER BLOW.

Metallurgical History

There are easily detectable characteristics about any industrial method that grew up without the benefit of technical help, and these appearances are very marked about the Bessemer process. Almost up to the present day, Bessemer operations proceeded with no benefit of technical supervision and assistance. A generation ago the Bessemer blower's responsibility to his superior rested more in his ability to keep out of trouble than it did in turning out a high-quality product, and keeping out of trouble meant particularly the avoidance of cold heats and heavily skulled ladles. Because of the blower's constant "playing safe" on temperature, heats were usually on the high side in temperature and frequently excessively so. This contributed to pipe, porosity, laminations, segregation, and to increased nitrogen content, materially favouring greater sensitivity to ageing and embrittlement by cold-work, all of which meant increased likelihood of breakage in fabrication and in service.

Of course, there was in those years a kind of embryonic appreciation of the effects of varying degrees of oxidation and the blower did blow "young" or "full" for an elementary and rather clumsy kind of control, but in competition with open-hearth steel, Bessemer steel in the period from 1900 to 1910 had little chance of a favourable or even comparable showing. With no metallurgical staff in existence, with manufacturing organisations that almost wholly failed to understand the technical points involved, and with a consuming trade so uninformed as to say "it breaks because it is high in phosphorus," it is a wonder only that Bessemer steel continued as long and in as large volume as it did.

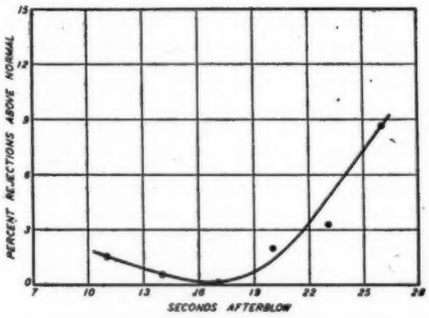

FIG. 2.—EFFECT OF VARIATIONS IN LENGTH OF AFTERBLOW ON INTERNAL SOUNDNESS OF INGOT, AS INDICATED BY CROSS-SECTIONAL ETCH TESTS.

It is a fact that throughout its history Bessemer steel has had certain qualities which in selected applications made it preferable, but a generation ago those qualities were not well understood and it was often applied where unsuited. The problem facing the Bessemer-steel metallurgist to-day is not just to change the inherent qualities of Bessemer steel, but rather to identify them and derive control of these characteristics so that they can be reproducibly placed at will at any given desired value.

In the past several decades Bessemer steelmaking has been neglected alike by management, sales, operators and technologists. It would be hard to find any phase of the steel industry a more fruitful field for research than the Bessemer process of to-day, or any field wherein results obtained would contribute to larger or more important economic and commercial considerations. Many steel companies have had large investments in Bessemer facilities; and these producers, faced by seriously diminishing use for these facilities, have been writing off their investment, abandoning it without a struggle. Strangely enough, it is the technologist who is raising a question about the wisdom and necessity for this course. He has suggested to the manager that if the Bessemer process were given even a portion of the lavish technical aid provided for the open-hearth process, it might regain its proportionate place, retaining its undoubted inherent advantages. An examination of this suggested position will be enlightening, even if the case is not proved.

Inherent Factors

In the past the charge has been made with some justice that Bessemer steel was less uniform than the open-hearth product. From a manufacturing point of view, the Bessemer process has certain elements of variability that contribute to non-uniformity and render control and metallurgical supervision difficult, partly through lack of chemical and physical control of the Bessemer process and partly because of the specific fact that Bessemer blows have been of smaller tonnage than open-hearth melts. To-day 150 tons of open-hearth steel would be made in a furnace at one time, representing a single set of values by any system of judging and evaluation. But even in the largest acid converters of to-day it would require six blows to make 150 tons of Bessemer steel, and that means six different sets of physical properties and six varying levels of workability and service qualities. This must be a disadvantage unless, as one now begins to see may be possible, the Bessemer process may perhaps be controlled with a precision that will be impossible in open-hearth steelmaking.

In speed of operation the Bessemer method proceeds so rapidly that variations in timing are serious in their effect on the product. The open-hearth melter deals with a finishing period of 1 to 2 hrs., and variations in tapping time may extend to perhaps 15 mins. without serious results, but the Bessemer blower is concerned with a finishing period of not more than one minute and his tapping times must be correct by a matter of seconds. This condition, too, might be considered as an insurmountably serious disadvantage of the process, but it will not be so if control measures of a comparable rapidity in time can be developed.

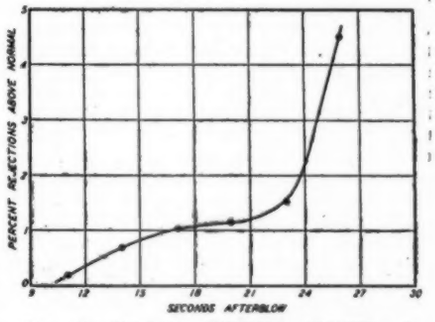

FIG. 3.—SURFACE DEFECTS RELATED TO LENGTH OF AFTERBLOW. OPTIMUM POINT HAS BEEN MISSED BY TOO LONG BLOWING.

Basis for Control

There is about the Bessemer process a simplicity that under sufficiently well organised handling should do much to support it in competition with other methods of steelmaking. In its essentials, the process involves only one raw material—liquid pig-iron, to which only one material is added during processing—compressed air. The finishing operation consists of the simple movement of a lever to turn down the vessel. The process is in a considerable sense automatic.

Two blows of Bessemer steel will be alike if blown from iron of the same analysis and "turned down" at precisely the same point. This may be stated a little differently by saying that two blows will be alike if blown at the same temperature and turned down at the same point. Variations in the heat-producing constituents of the iron may be compensated for by variation in the cooling materials used. The usual cooling materials are steam, scrap or iron ore, all of which in one way or another

absorb heat from the liquid bath. Iron ore also increases the slag volume and by assisting to oxidise the silicon shortens the blowing time as much as 20 to 30 per cent. Bessemer operators and metallurgists have long been suspicious of steam as a coolant, supposedly because of the absorption of hydrogen. There is considerable difficulty, however, in isolating the effect of steam from other variables, and the case against it is certainly not clearly established. If no other alternative were available it would seem better to use steam than to allow a blow to progress and finish at too high a temperature.

While it is possible, in theory at least, to control the quantity of coolants used, based upon the silicon content of the iron, there are practical difficulties in the way of originating dependable tables showing weights of scrap or ore to be added or steam to be used. A fair share of troubles with the quality of Bessemer steel are far from being purely the responsibility of the Bessemer operator. Many of these troubles trace to a combination of variations in iron quality with the peculiar operating characteristics of the Bessemer converter. The Bessemer blower has to deal with iron that may vary rather widely from charge to charge in heat-producing constituents, nor does he know with any degree of accuracy what this variation is. Under such circumstances his control of temperature can only be all too uncertain.

Iron analysis available in a steel plant is ordinarily the average for an entire blast-furnace "cast" of perhaps 150 tons, and the range of silicon content between maximum and minimum covered by the average reported for a cast may be considerable. There is always a good bit of uncertainty as to the degree of mixing that actually takes place in a mixer, and the mixer operator is never too certain as to the proportionate weight of partly used casts of iron still remaining in the mixer. The usual calculated "mixer analysis" as provided to the Bessemer operator is very often fairly wide of the mark.

An honest evaluation of the situation leads to the conclusion that until the blower is accurately informed as to the silicon content of the iron being charged into the converter he cannot very fairly be held responsible for considerable variation of temperature. It may be claimed that the blower should be a sufficiently good estimator of temperature to judge the progress of the blow, but it is a little severe to hold the blower as almost the only man in the whole steelworks without instrumental assistance in judging temperature. In any event he can form little estimate until the silicon blow is over, and a really sound estimate of temperature is scarcely possible until the heat is well into the carbon blow.

The Time Factor

Quality and uniformity of product are not served by a policy of holding the blower responsible for blowing iron of a (to him) unknown degree of variation in heat-producing analysis with no remedial measures possible except additions of coolants, which can be added only after some of the damage of a high temperature has already occurred.

Accepting the problem merely as one of providing the blower with accurate knowledge of the silicon content of the iron he is blowing, it resolves itself into a matter of determining the analysis of the iron drawn from the mixer for a particular blow and of reporting that analysis to the blower when that same iron is being charged into the converter or very quickly thereafter—at least before the temperature of the blow has "got out of hand" and while there still remains time to take corrective measures. Analytical technique of this order of speed is not in existence to-day. Even the most rapid existing spectrochemical procedure would not do much better than report to the blower on the blow previous to the one actually in the vessel. Nevertheless, it does not seem impossible that some method can be developed, and the question is being studied.

The discussion above deals only with determining the extent of such variations as exist in silicon or other heat-producing elements without respect to the control or elimination of such variations. No survey of Bessemer operation can be complete, however, without consideration of these variations. Superficial thinking would be inclined to consider two blows of the same finished quality even if one were made with a higher silicon iron, providing this higher silicon were balanced by a scrap addition to produce the same blowing temperature.

Research indicates, however, that variations in silicon affect the quality of finished steel even if temperatures are closely the same. These indications point to the conclusion that for best uniformity of product successive blows should be produced with closely the same slag volume of substantially uniform analysis. Such a situation could presumably be met by operating the blast furnace at a somewhat lower silicon level, determining the analysis of each charge of iron for the Bessemer, and by addition of ferro-silicon to bring the silicon content up to some substantially uniform level.

It is obvious, however, that if this situation assumes the importance suggested here, sensible handling thereof would bring back to the blast-furnace operator an increased measure of responsibility for decreasing the variations in his product. There are methods known for improvements along this line, detailed discussion of which lies beyond the scope of this Paper. Realisation of these improvements has been retarded by considerations of cost of investment and operation but if the development of methods in the Bessemer to help the blower becomes seriously expensive, this fact will help to establish a case for improvement in iron uniformity by efforts in the blast-furnace department.

Inherent Heat

Another feature of the control of temperature in blowing is that the sensible heat of the iron is more important than might be supposed. The development of a dependable device for measuring iron temperatures is highly important and fortunately real progress is being made in this direction. Other considerations also suggest the probable desirability of refrigerating the Bessemer blast to a substantially uniform year-around temperature and moisture content.

Early in organised research work on Bessemer operation it will be discovered that complete and dependable control of blast pressure and volume is highly desirable. Tabulated records will show that there is an optimum pressure that must be held within fairly close limits. Variations such as may be caused by two converters being blown from a common blast main will rob blower and metallurgist of much of their power of control.

All of this discussion summarises itself into the statement that in spite of the tremendous simplicity of the Bessemer process with only two raw materials, iron and air, the quantity and quality of these must be known and controlled to permit control of the quality of the product and uniform reproducibility thereof. The temperature of the iron and its heat-producing content must be known and controlled, and the volume of air and its humidity and temperature must be considered. Real progress in Bessemer operation will require much finer manipulation of these factors than has existed in the past. Improvement in this direction will tend to remove the necessity for some of the rather blind and awkward procedure the blower has had to use in the past.

End-Point Determination

Since the Bessemer process is essentially automatic in character, it will, if properly charged, proceed satisfactorily; but the end is not automatic. In fact, at a given moment the charge begins to "commit suicide," so to speak, by burning itself back into iron oxide. This change takes place with great rapidity and therefore precise control of the end point becomes a matter of greatest importance.

A few years ago, in the midst of organising forces for comprehensive and intensive research on the Bessemer process, it was proposed that the luminous energy of the flame as measured by a photocell arrangement might form a basis for control. Subsequent development work by the research and plant metallurgical staffs has produced a method that has very helpful control features. The flame is viewed by a suitable photocell and amplifier arrangement and a continuous graphic record is obtained of the energy registered. The chart record for a representative blow is shown in Fig. 1.

The chart record in Fig. 1 reads from right to left instead of the usual left to right fashion. The energy of the flame is low during the oxidation of the silicon, but increases to a high level during the oxidation of carbon. When the carbon is reduced to about 0.15 per cent., at point A on the chart in Fig. 1, the flame intensity drops quickly to point B, where at about 0.04 per cent. carbon there occurs a slight retardation in the rate of decrease of flame energy. The change at point B is a critical moment in the end of the Bessemer blow and B is an important datum point on the "electric eye" charts. As the vessel is turned downward into a horizontal position, it reaches a point where the steel bath drops below the bottom tuyeres and the unimpeded flame impinges on the shield in front of the converter, producing a "flashback," which registers on the chart at point C. At this point all normal blowing action ceases. The portion of the blow between points B and C is in this Paper referred to as the "afterblow," the time in seconds being measured laterally on the chart. The term "afterblow," however, should not be confused with the dephosphorising afterblow in basic-Bessemer practice, since this phase is entirely absent in the operation of acid converters.

The blow in Fig. 1 lasted for 10 min. with an afterblow of 23 secs. The shape of the curve of flame energy is representative, but the length of the blow is shorter by 1 or 2 min. than average and the afterblow is 5 to 10 secs. longer than usual.

With this system in operation, it was possible, for the first time in Bessemer history, to check the blower's visual estimations against an instantaneous, instrumentally-obtained record. It follows that it was for the first time possible to get, devoid of human equation, an evaluation of the time factor at the end of the blow. How fast were reactions proceeding during the critical period? If, for example, iron oxide content of slag and metal were to be kept within certain limits, what did those limits mean with respect to seconds elapsed from the instrumentally-recorded end point? No one had ever known whether a difference—call it error or variation, as one will—of 5 secs. was serious or whether 10 secs. or even more was permissible.

Fig. 2 indicates that this situation can be clearly evaluated. Taking point B in Fig. 1 as a datum point, Fig. 2 shows how varying the end of the blow affects etch-test rejections of Bessemer screw steel. The study includes results on 12,350 billets, 4 by 4 in. and larger. The curve shows that steel outside of a range of ± 3 secs. from the optimum point increases

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Some Points in Casting Production

MOULDING OF LARGE BORING-BAR CASTINGS DISCUSSED IN MANCHESTER

A large attendance of members of the Lancashire Branch of the Institute of British Foundrymen was recorded at the November meeting in Manchester, when MR. E. LONGDEN, A.I.Mech.E., delivered his Paper on "Some Points in Casting Production" (see our December 12 and 19 issues). Appreciation of the practical character of the Paper was evidenced by the discussion, which touched on many different problems involved in the moulding of large boring-bar and similar castings such as were described by Mr. Longden. A report of the discussion is given below.

Vote of Thanks

MR. T. MAKEMSON, in proposing a hearty vote of thanks to Mr. Longden for his interesting and valuable Paper, said he was not surprised at the large attendance of members who had come to hear it read. Mr. Longden's lectures were always welcome, because he invariably presented something new and dealt with it in an unorthodox manner, describing something which was usually a little out of the ordinary run of work for most foundryman. Members had not been disappointed in that respect, for they had heard described big castings which were certainly beyond everyday practice.

MR. HAROLD HAYNES seconded the vote of thanks. Speaking as a young man, he said the Paper and the lantern slides exhibited caused him to wonder at the vast amount of thought and trouble which had been necessary to produce the huge castings described. He observed that Mr. Longden had not told the members how he obtained the long boring bars straight, although he had mentioned the mixture of the metals and the positioning of cores, etc. He had shown how he cast a hydraulic ram from the top, and then cast another ram partly in the middle, helped with down-runners from the top. Personally, Mr. Haynes thought the rams ought to be cast straight down from the top, as was done for the small one. As for the core, he remembered a hydraulic ram being cast 35 ft. long, 14 in. dia., and with a 4-in. core, which was screwed down to the bottom to stop it lifting upwards. The casting was very satisfactory.

Camber Allowances

MR. LONGDEN, after suitably responding to the vote of thanks, said that camber was a very important consideration in the designing of the cored bar. No trouble was experienced with the solid bars because they were symmetrical and the cooling was fairly uniform, except for just a slight difference in the casting at the bottom side of the mould over the top, by virtue of its position. Only ¼ in. of camber was needed in the solid bar, which was 45 ft. in length. The cored casting was studied with a view to arranging for similar cooling conditions as obtained in the case of the solid bar, and it was designed to have as much metal on the top side of the casting as on the bottom. Again, in the case of the 47-ft. length of cored casting, only ¼ in. of camber was required. The casting was perfectly straight, after cooling to normal temperatures.

With regard to the top pouring of rams, the first illustration had shown a ram, but the second was of a 20-ton hydraulic cylinder—a very much larger casting than the ram, which weighed only 75 cwts. He thought the top-pouring of rams and cylinders was very often determined by the kind of tackle available, usually of a make-shift character. No one should attempt to drop metal from a height of 35 ft. unless compelled to do so, owing to the restricted kind of tackle that the shop possessed. Boxes should be available which would permit of the running of a percentage of the metal down the side of the mould and in at the bottom of the casting, thus providing a cushion of metal for the bulk of the iron to follow. It would be very wrong to take an unnecessary risk when there were facilities to pour reasonably and safely with a combination of bottom and top gates. In the case of the 20-ton cylinder, about 25 per cent. of the metal was poured in at the bottom, the top drop gates were then brought into action, and the pounding of the surface of the rising metal by the falling metal would bring the sullage well up into the header.

Machined Moulding Boxes

MR. E. J. WHITE, referring to the short section of pattern which was used when building up the mould for one of the jobs described, asked whether a machined jointing box was used for each section. He thought it would materially help in getting a true alignment when putting the mould together. Would Mr. Longden merely centre them according to the ordinary practice in the shop? He had in mind a special lathe, which was rather a long job, and somewhat complicated in section, due to the fact that there might be about three varied diameters and then a large flange on the top. Assuming there was pouring from the top with the ordinary basin and pencil runners, and a run-through head where there was the top flange, would Mr. Longden suggest that the diameter of the head was equivalent to the flange, and machine it out of the head-piece? Then lower down the part set to take the second diameter, instead of using nails to support the fillet, where the one diameter fell to a smaller section, would it be advisable to put a good densener in the same lower section, instead of using nails to support it?

MR. LONGDEN said that denseners would be helpful.

MR. WHITE indicated his point by means of a sketch on the blackboard. He emphasised that by chilling underneath the radius where the differing sections met, instead of using nails, a sounder casting would be produced. Possibly carrying the head-piece right across, and machining the surface out of the flange, would be detrimental. By changing the position of the head, the pencil runners and the basin, was there any possibility of affecting the machining, and of the casting becoming porous? He asked whether it would be an advantage to use denseners instead of wire nails.

Section Coremaking

MR. LONGDEN replied that in the case of the 20-ton hydraulic cylinder the moulding boxes used were machined on the joints. It was impossible to secure shapely castings when superimposing sections of mould, without having some assurance that the joints were perfectly straight. There was, however, a way of using unmachined boxes, by having a section of a pattern long enough to permit a moulding box being located, and to keep drawing the pattern upwards, followed by ramming, and the further addition of moulding boxes, and occasionally removing the lower boxes from which the pattern had been withdrawn. A sand joint was made with each box addition. In such a case it was unnecessary to have machined joints on the boxes. He used a similar class of box at the present time.

With regard to the making of cores, it was not always necessary to make strickled loam cores. Long cores could be built in sections, corresponding with the mould sections, and the short sections built around a core barrel after locating it in the bottom boxes of the mould.

Core Handling Methods

He had had a somewhat disturbing experience with long cores, such as for the hydraulic cylinder. It could readily be imagined that a heavy core about 40 ft. long would have to be carefully handled to the vertical position, if the core was not to be bent or broken. After two core failures he instructed the foundry to make a cast-iron cradle, to support the core until lifted to the vertical position in the corner of the casting pit. The core was strapped to the cradle and held safely. It was then quite simple to release the core and place it in the bottom sections of the mould. He had had made similar classes of cores since that earlier experience, but had not made the usual strickled loam cores.

Dealing with the 15- to 16-ft. casting, outlined by Mr. White, Mr. Longden stated that it would not be wise to drop the metal from the top. In the case of the casting illustrated it must be poured from the bottom, because of the shoulders and acute changes in section in the mould, which would cause erosion of the outstanding parts of the mould if drop-gated. The metal could not drop clear down the mould without impingement somewhere. If denseners were used at these localities, there would be overheating and burning-on of the denseners, and the result would be a blown casting. The denseners might be used at the points named if the casting was bottom-poured.

Wide Applicability

MR. JACKSON remarked that Mr. Longden had drawn attention to a certain feature of casting, which appeared to be applicable to quite a quantity of foundry work. He had stressed the faults of the old methods of feeder heads and also a new line of risers instead of feeders. In his (the speaker's) opinion Mr. Longden's success was due to the application of small aluminium pieces in the risers to liven and quicken the metal and to assist in lifting the sullage. Apparently, this method could be employed in the making of many castings with very successful results. It was, certainly, a very great advantage to liven up the metal and get it to flow and creep away better from the danger points. What was the correct percentage of core oil to sand used for the boring bars? The percentage stated seemed in error.

Oil-Sand Mixtures

MR. LONGDEN, referring to the composition of the oil sand, said that the stated figure was an error; the mixture consisted of 1 part of good-quality core oil to 25 parts of large-grained clean sand. The extra oil was introduced on account of the mass of metal which surrounded the cores, the sand being open-grained in order to take care of the extra oil. The ebullition caused by the activity of the aluminium, placed across the risers, was very helpful in clearing a way forward for sullage and gases, but it was not the main contribution to the general soundness, which was obtained without the huge headers normally necessary.

Use of Chills

MR. J. POTTER inquired what was the purpose of using cold chills. Were they only used once or on several occasions? There must be a big weight of metal in the chills for such a length.

MR. LONGDEN said that the total weight of the 2-in. cube denseners was approximately 7½ tons, but it had to be borne in mind that three

castings were required. The same type of cube densener had been used frequently, previously, on other castings. The cube denseners made for the boring bars were still in use, some years after being made. The denseners were not exact cubes; each face was different, one face carrying a flat while each of the other faces carried different radii. The denseners were, therefore, serviceable for a variety of diameters and castings of differing shapes. Comparing the 7½ tons of densener metal against the amount of metal which the orthodox feeders would require, there was a very favourable comparison. If the ordinary headers were employed, approximately 2 tons 12 cwts. would be taken for each casting, and, for three castings, roughly 8 tons of head metal. Thus there was really nothing in the amount of molten metal needed. The denseners were made very quickly on a power moulding machine. The first consideration being, of course, the production of a sound casting, it was far better to make 7½ tons of denseners, or iron bricks, to produce about 46 tons of castings, than to be afraid of such a piece of expenditure. The result was a superior casting. The fettling of the small risers compared with the large ordinary feeders was an important item in favour of the newer method.

Influence of Mould Rigidity

Replying to Mr. R. S. Turner, MR. LONGDEN said that the production of such a casting was well ahead of anything else which had ever been done in regard to the use of denseners. Given a mould which was sufficiently strong and as free as possible from gas-forming elements, important castings could successfully be made, perfectly free from unsoundness. A mould must be sufficiently strong to resist the expansions which operated in cast iron during the cooling. Such conditions would favour a reduction in liquid shrinkage influences. The cooling curves of the bars showed two distinct arrests and expansions, due to the precipitation of graphite from solution. The first expansion effected the amount of liquid shrinkage. The idea, expressed by Mr. Turner, of supporting a mould by packing it to the box, was quite sound and helpful. A yielding mould which was liable to be pressed backwards by ferrostatic pressure militated against securing a sound casting. The stronger the mould could be made, together with freedom from gas which would create disturbance of the metal, and be late in evacuating from the mould, the more it would help in producing a sound casting. It was always possible to make many types of castings in the manner outlined. If the casting was important it was advisable to make the strongest possible mould. The chilling effect of the 2-in. ring of denseners was sufficiently severe, a solidified ring of metal being quickly formed on the casting, which ring in itself somewhat resisted external expansion. The metal was of a moderate compositional strength, but the casting showed a grain which took on a high polish, as many members present at the meeting could vouch for. Such a close grain and polish could not be obtained with the lowest possible silicon content, and with the headers needed for normal practice it would be impossible to obtain sound metal at the junction of the heads with the mass of the casting.

Object of Chills

MR. TURNER asked what was the object of the chills.

MR. LONGDEN replied that the reason for using denseners was to produce a strong mould and freeze the outer layers of metal quickly, in order to resist the shell expansion following graphite precipitation, in a normal greying iron, so that liquid shrinkage could be largely nullified. Normally, an ordinary mould would yield under the pressure, and would, consequently, require headers to feed the liquid shrinkage. Therefore, there were two distinct aids to soundness: there was the strength of the metallised mould, and the quick freezing of the outer shell of the casting, together restricting the future carbon changes, as solidification progressed layer by layer. The growth of graphite would be directed towards the still molten interior, thereby reducing shrinkage. The expansive force set up by the growth of graphite was a contributory cause of the bursting of certain classes of chilled rolls.

Temperature of Casting and Use of Aluminium

MR. F. ANDREW said he had heard Mr. Longden refer to temperature. What was the action of aluminium? Was it similar to the action of Thermit, and, if so, where was the oxygen to come from?

MR. LONGDEN observed that he had pointed out, early in the lecture, that the pouring temperature was between 1,450 and 1,480 deg. C. Respecting the aluminium reactions, after all, there was oxygen in the air, but there was insufficient present to create the intense Thermit reaction. The aluminium was practically melted before the metal—cast iron—reached it, its melting point being fairly low. It created some thermal activity and ebulliency around the riser entrance. The Thermit process involved a mixture of metallic oxide and aluminium powder, and the thermal reaction was very rapid. Aluminium, in small percentages, increased the fluidity of cast iron, directly, by alloying with it, and there was certainly an exothermic reaction about the riser throat.

Runner Box Practice

MR. HAYNES inquired whether, in running the casting, dry sand was used or dried runner boxes were employed. If the risers were left open, why was a weight put down to close them?

MR. LONGDEN said that the general practice was to use loam pouring basins. There was, in his firm's foundry, a set of semi-permanent runner boxes which only required face loaming and drying after each cast. This was standard practice. They would never think of risking a large casting without a thoroughly dried pouring basin. Weeks might be spent in the making of a mould and it could be spoiled by the neglect of the running basin.

The riser openings were not weighted down, they were left open during the casting operation. The small pieces of cast iron, referred to as weights by Mr. Haynes, were placed temporarily over the riser openings during the final drying process, as shown in one of the illustrations. Risers should be closed when the upper surface of the inside of the mould was open and exposed to the glare of the metal. There was the tendency in such cases for the sand face, exposed to the rising metal, to expand, buckle and fall into the rising metal below; this was aggravated by the gases generated on the upper surface of the mould flowing downwards into the mould, instead of upwards, through the sand.

Machining Allowance

MR. J. E. COOKE understood Mr. Longden to state that ¼ in. was added at the sides and bottom and 1 in. on the top. In view of the fact that the castings came out so extremely straight, what was the reason why so much machining allowance was necessary?

MR. LONGDEN, replying, said that ¼ in. was allowed on the top face and ⅛ in. towards the bottom face. Whilst they did not see the first casting machined before proceeding with the succeeding castings, they came to a decision that it was necessary to continue with the same machining allowance as for the first casting. It was found that if less allowance had been given, trouble might have been encountered. In spite of the combination and distribution of the runner gates, a collection of sullage would be inevitable on the upper face of the casting. There was a large quantity of metal to pass through such moulds for boring bars. In the ordinary way, if the casting could be poured vertically, a large header would take care of the sullage. The cost of machining was very small, compared with the need to produce a sound casting.

Alternative Methods

MR. A. SUTCLIFFE, sen., confessed he would like to learn how much Mr. Longden charged per cwt. for the casting. The boring bar probably belonged to a lathe, so that its cost would naturally fall upon the lathe, and what was lost on the swings would be gained on the roundabouts. He would have run the job on the top with two sets of runners, one about 6 ft. from the end and another 6 ft. from the other end, with the feeders in proportion, as necessary. Could not the bar have been made in two and dowelled and cottered? He had made solid bars 35 ft. in length without any trouble. They were made in boxes, and not by core work with much complicated work attached to them. A level bed would be made on the floor, and the work would carry on, even though it went on with a short piece of pattern. The boxes would be lifted up and the parts put in the stove and dried. He did not know but what the bars he had made long ago were still in use.

Demand for Quality

MR. LONGDEN remarked that all types of castings had been more or less successfully made in the past, but there were certain high qualities required nowadays, however, which would not or could not have been obtained in the way foundrymen were compelled to make their castings in days gone by. He could differ acutely on a definition of a solid casting. Very open-grained structure, almost amounting to cavity (and cavities occurred also) under large headers could not be claimed to be a mark of solidity. The marks which appeared on the casting were not made by sprigs, as suggested by Mr. Sutcliffe. How would it be possible for anyone to distinguish sprig marks on a small photograph of a 47-ft. length casting? The marks were caused by the 2-in. cast-iron cube bricks. He reminded Mr. Sutcliffe that to run the castings on the top would be disastrous. Wherever the metal impinged on the denseners there would be burning-on with the resultant blowholes. This was the trouble with denseners. To make the casting in two pieces, as in the one made by Mr. Sutcliffe, was the logical thing to do, of course; but his firm had not a deciding voice in the matter. The boring bars were an outside job and did not form part of a machine made by his firm. The castings were obtained by open competition, and the price obtained was satisfactory when the castings were manufactured as described. Produced in any other way the costs would be very much higher. Disagreement had been expressed by Mr. Sutcliffe with the headers he had described for liners and rings, cast on end. His (Mr. Longden's) suggestion was that cavities would always be found in headers close to the central core. If the header was tapered inwards, instead of outwards, the hottest zone of the header would more nearly correspond with the centre line of the hottest zone of the header, than if tapered outwards, towards the quicker cooling outside of the casting. After all, the header might be made in such a manner as to obtain a porous place under the head, and in the casting, in spite of the large amount of metal in the header.

The BRANCH-PRESIDENT (Mr. W. Holland) said he knew he was asking Mr. Longden for

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For High Quality Castings

The increasing demand for high-strength close-grained iron castings calls for improved metal. In comparison with the accepted standards of the past, the modern high quality casting requires lower total carbon and phosphorus, with a closer range in silicon. The Ironfounder can now meet this demand at a reasonable cost by the use of Stanton-Dale Refined Pig Iron.

Stanton-Dale is a pig iron of low total carbon, the graphitic carbon being uniformly distributed and of fine curly-flake formation. The close structure ensures remarkably high strength with good machineability, and Tensiles of 16 to 20 tons can readily be obtained when a proportion of Stanton-Dale Iron is introduced.

The use of this iron avoids the irregularities in structure which are sometimes observed when steel scrap has formed part of the charge.

The correct grade of Stanton-Dale Iron to use depends on the type and class of castings to be made. The Stanton Technical Service is available to advise on suitable mixtures.

Total Carbon from 2.6 per cent. upwards. *Analysis to individual specification as required.*

STANTON-DALE
REFINED PIG IRON

The Stanton Ironworks Company Limited, Near Nottingham

The Largest Producers of Foundry Pig Iron (for Sale) in Great Britain

Heating Air-Raid Shelters

The problem of heating air-raid shelters is not an easy one. The warm air current from a stationary heater rises to the roof, and with nothing more to promote circulation of air, occupants may feel the benefit so far as the upper portions of their bodies are concerned, but their legs and feet are almost certain to suffer from cold. Some form of heater which can be placed external to the room to be heated, thermostatically controlled and capable of maintaining free circulation of warm air to all parts of a shelter appears to be the best type of apparatus.

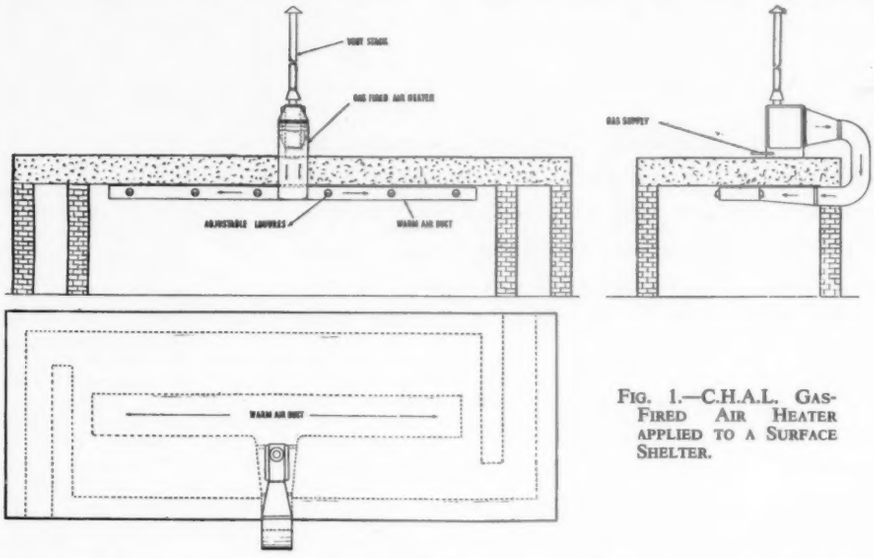

FIG. 1.—C.H.A.L. GAS-FIRED AIR HEATER APPLIED TO A SURFACE SHELTER.

Such a unit is the Controlled Heat and Air patent gas-fired air heater. A suitable system of ducting arranged inside the shelter is fitted with adjustable louvres, ensuring efficient distribution of the warm air over the whole of the shelter space. These louvres can be so adjusted to give an air stream in almost any direction, and the amount of air emitted from each louvre can be determined by the turning of a small screw. All the heat supplied to the shelter is in the form of warm air, and there are no fumes or places of high or of low temperature. For protection against poison gas, the air inlet to the heater unit can be a stack carried above the probable gas line, and since the air-raid shelter is under a slight pressure due to the plenum caused by the heating system, the shelter would be gas-proof except for what might be drawn in through the air-inlet. There again the inlet air to the heater can be made to pass through a gas-cleaning apparatus. During the summer months, when the necessity for heating arises only occasionally, the heater may be used as a simple ventilating unit by turning off the gas supply; also a deodorant may be introduced on the delivery side of the heater if desired.

Essentially, the gas-fired heater is a tube-type interchanger, fired by a system of bar burners of special design. The air tubes, which are welded into end plates of heavy-gauge mild steel, are graduated in size from bottom to top to ensure that the thermal efficiency is obtained. False side plates, forming additional air spaces, are incorporated in the design, thus ensuring that the sides of the casing remain cool and improving the thermal efficiency of the apparatus by cutting down the radiation surfaces to an absolute minimum. Fig. 1 shows how a gas-fired unit is applied to a conventionally designed surface shelter.

An electrically-heated unit has also been designed, and this consists of a specially-designed, electric-heater battery, self-contained and complete with motor-driven ventilating fan. The casing for the heater battery would be so designed to connect up to almost any system of ducting. The motor is totally enclosed, and the filter unit is complete with switches and thermostatic control. Fig. 2 shows a conventional type surface shelter heated by means of such a unit.

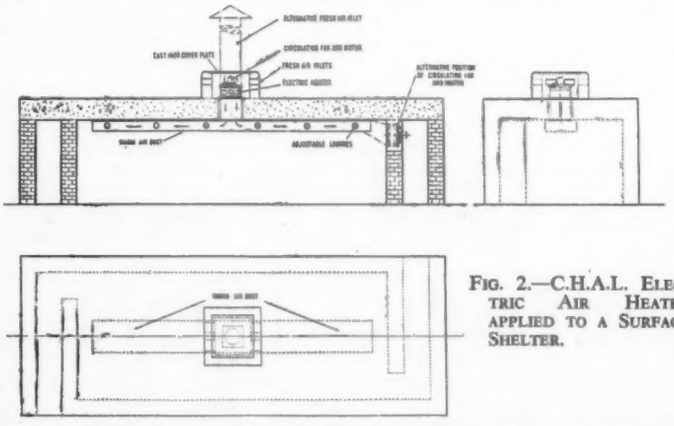

FIG. 2.—C.H.A.L. ELECTRIC AIR HEATER APPLIED TO A SURFACE SHELTER.

The heaters are made in sizes from 1,000 to 7,500 cub. ft. of air per min., the quantity being measured at inlet temperature, and any desired temperature rise may be obtained. Standard units are designed for temperature heads of 50 deg., 70 deg. and 100 deg. F. respectively. The heaters are manufactured and marketed in Great Britain by Controlled Heat and Air, Limited, whose offices and works are at Cornwall Road, Smethwick, Birmingham.

The Randupson Process

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point, whilst a very high temperature would considerably affect the setting time. They did not give any special heating. His instructions were that the temperature should be maintained at a minimum of 55 deg. F., but he would say that as many instances of 48 deg. were recorded as for 55 deg. They did not take any special precautions beyond that their foundry was heated sufficiently to comply with the Factories Act in the winter months.

Usually there was shrinkage of the moulds, but it was very slight. No special allowance for it was ever made in patternmaking, the difference being infinitesimal between the cement and ordinary sand. Whilst the sand was considerably harder and stronger than an ordinary sand, it would not stand any more, and it would not withstand any less impingement of metal than a very good dry sand.

Coarse silica sand was usually rather expensive, and they found it more economical to use ordinary silica sand. The former was slightly better, but not sufficiently so to warrant the increase in price.

Vote of Thanks

MR. F. G. BUTTERS, proposing a vote of thanks, felt sure that all the members had appreciated the efforts of Mr. Rowe in giving them such a very interesting lecture.

MR. H. J. BECK seconded, saying he was sure they had all listened with great pleasure.

MR. ROWE briefly replied.

Some Points in Casting Production

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another lecture, but would he state his method of taking the measurements to make the graphs? The information would interest all members.

MR. LONGDEN then gave the desired information with the aid of an illustration and the lantern, explaining that although the process was tedious it was very accurate.

MR. R. A. MILES hoped that Mr. Longden might be induced to give another lecture. It was a matter of wonder how he had developed his ideas to the extent of making an experiment of the character he had described when making a bar with such cores. Mr. Longden must have been inspired with a very large degree of confidence in the ultimate success of the experiment when he initiated it.

The Acid Bessemer Process of 1940

(*Continued from page* 414.)

rapidly in pipe and porosity with corresponding decrease in yield of good material.

It is reasonable that there might be a different optimum point for each grade of steel, or for each standard for quality evaluation, and there is some evidence that this is true. A study such as is diagrammatically shown in Fig. 2 may even show that for a given condition in a given grade of product, the optimum time of turn-down is missed entirely. Such a situation is shown in Fig. 3, which plots the percentage of surface defects above normal against the seconds afterblow for approximately 9,000 tons of sheet bar. With a precise instrumentally-determined end point available, compilation of data such as are shown in Fig. 3 is simple, and the correction is relatively easy.

(*To be continued.*)

Fry's Tube Bending alloy

The old method of filling and bending of tubes with rosin, sand or type metal often led to cracking or distortion of the tube and the filling was difficult to remove. A modern alloy is available which can be melted in hot water, is simple to use and has a slight expansion on cooling, which is an advantage.

METHOD OF USE:

Melt the alloy in hot water. Plug one end of the tube and pour in molten metal; the alloy will displace the water. Allow to cool and then bend tube into desired shape. Take out plug and immerse tube in hot water; the metal will run out and can be used over and over again.

PHYSICAL PROPERTIES:

1. Melting point 71° C.— 160° F.
2. Weight, grams per cub. cc., 9·75.
   Weight, lbs. per cub. in., 0·353.
3. Alloy *expands* on solidification by $\frac{1}{16}$ in. per foot.
4. Ultimate tensile strength, 1·56 tons per sq. in.
5. *Elongation 280%.*
6. Brinell hardness number, 7·9.

Test samples and further information will be submitted on request.

FRY'S ARE SPECIALISTS IN THE MANUFACTURE OF ALL TYPES OF SOLDER AND FLUX FOR GOVERNMENT AND CIVIL WORK AND ARE WILLING TO ADVISE ON ANY SOLDERING PROBLEMS OR DIFFICULTIES.

FRY'S METAL FOUNDRIES LTD

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The Week's News in Brief

Trade Talk

A CLAIM has been lodged for increased wages for women in the engineering industry.

MISS MEGAN LLOYD GEORGE, who is chairman of the Women M.P.'s Salvage Advisory Committee, stated that over 25,000 tons of railings had been collected by the Ministry of Supply, when she inaugurated a "scrap the railings" campaign for a London Borough Council last week.

EMPLOYEES in the Torwood Foundry of Jones & Campbell, Limited, Larbert, have contributed £412 to charities in the area over the past year. Employees of the North British Locomotive Company, Limited, at the Hydepark and Atlas Works, Glasgow, have given £1,208 to local infirmaries and charities.

IT MIGHT be thought from our last week's paragraph that British Pigirons, Limited, had completely vacated Abbey House, Westminster. This is by no means the case, and a staff is still retained there. The telephone number of the Woking office is Byfleet 3100, and the telegraphic address is similar to the London one, but is Ironobrit Phone Byfleet.

MR. ERNEST BROWN, M.P., Secretary of State for Scotland, recently inspected the students at work in the Technical College, Falkirk, and displayed great interest in the model foundry of the school. He expressed the hope that students after training would take advantage of the Government's training scheme, and thus play an important part in the winning of the war.

COLONEL D. MACKINTOSH, C.B., M.V.O., chairman of the St. Andrew's Ambulance Association, formally received a fully-equipped ambulance from Mr. F. L. Burder, chairman of the Carron Company, as a gift from the chairman and directors of the Carron Company. The ambulance is to be named after the company, and a special parade of donated ambulances took place at the presentation.

T. S. WILSON & COMPANY have transferred their offices permanently from 9 and 10, Great Tower Street, London, E.C.3, to Billiter House, Billiter Street, E.C.3 (telephone, Royal 5360). They have also transferred their works from Cuba Street, Millwall, E.14, to larger works premises, in order to accommodate increasing demand, at Eureka Mills, Manchester Road, Cubitt Town, E.14 (telephone, East 2360).

ARRANGEMENTS have now been made for the hearing of claims by the National Arbitration Tribunal of engineering and shipbuilding unions for an increase in wages. The Amalgamated Engineering Union and the National Union of Foundry Workers will appear before the Tribunal on January 7, the joint engineering trades, representing all the other unions in the industry, on January 8, and the Confederation of Shipbuilding and Engineering Unions on January 16.

A RELIC of George Stephenson has been received by the Council of the Institution of Mechanical Engineers, as a bequest under the will of the late Mr. T. A. Common, M.I.Mech.E. It is a small silver loving cup, which had been in Mr. Common's possession and in that of his father, the late Mr. Alfred Common, F.R.S., for many years, and it bears the inscription: "A Loving Cup from Robert Allcard to George (Geordy) Stephenson of Killingworth."

THE largest ironworks in Japan is passing through a critical time, for the whole of the board and a number of auditors have resigned owing to the slowness with which a reorganisation of the Japanese iron industry is taking place, and which the directorate consider should be expedited to make the industry independent of Great Britain and the United States. It is difficult to see how the industry can become independent in present circumstances, with the absence of a reliable raw-materials basis.

TO ASSIST owners of factories or other premises, the Board of Trade has issued a leaflet bringing together all the necessary information as to steps to be taken to obtain materials to repair, or licences to rebuild, premises and plant damaged by enemy action. In view of the need for the greatest economy in the use of materials and labour, the leaflet tells owners that they can expect to be allowed to carry out only "first-aid" repairs, unless they are engaged upon essential work. Copies of the leaflet may be obtained through local authorities or direct from the Regional Licensing Officers of the Ministry of Works and Buildings, or from the Regional Officers of the Ministry of Health.

PRESIDING at the annual meeting of Birmid Industries, Limited, Mr. Cyril C. Maudslay (chairman) said that since the end of the financial year they had concluded arrangements to take an interest in the Perry Barr Metal Company, Limited, which was interested in the manufacture of light alloy castings and in the production of fabricated engineering assemblies and machined components for the aircraft, motor and allied trades. In spite of the fact that all their factories had been working at top pressure during the year, they had maintained their policy of carrying out improvements and adding to their resources, and close consideration was being given to the continuance of their activities and the progress of the group after the war.

Personal

MR. R. B. HODGSON, a director of the Whessoe Foundry & Engineering Company, Limited, Darlington, recently celebrated his golden wedding.

MR. DESMOND LYSAGHT, a director of John Lysaght, Limited, Newport, has been nominated for the office of High Sheriff of Monmouthshire.

MR. A. J. GRANT, managing director of Thos. Firth & John Brown, Limited, Sheffield, has been elected a member of the Council of the Industrial Welfare Society.

MR. J. LLOYD BENTLEY, of Darlington, has been appointed manager of the Wolsingham Steel Company, Limited, Co. Durham, and will take up his duties at the beginning of next month. Mr. Bentley was born in Sheffield and served his apprenticeship with Cammell Laird & Company. He was afterwards with the Darlington Forge, Limited, and latterly with Dorman Long & Company, Limited, Middlesbrough.

MR. HANS RENOLD has had conferred upon him by Manchester University the degree of Doctor of Science *honoris causa* in recognition of his services to engineering, including the invention of the precision chain. Mr. Hans Renold is a director of the Renold & Coventry Chain Company, Limited. He was born at Aarau, Switzerland, in 1852, and became a naturalised British subject in 1881, two years after he had started in business in Salford as a manufacturer of balance, monkey and roller chains.

Wills

CLARK, W. F., managing director of James Archdale & Company, Limited, machine-tool makers and ironfounders, Birmingham ...	£22,869
CHAMBERS, FREDERICK, of Belmont, Chesterfield, chairman of the Renishaw Iron Company, Limited, and a director of the Sheffield Wire Rope Company, Limited, the Bryan Donkin Company, Limited, Digby Colliery Company, Limited, and other companies ...	£101,458

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Robert Russell (Brassfounder, Oldham), Limited, Mortar Street, Oldham, Lancs—Capital, £1,000. Directors: R., S., and H. Russell.

G. F. E. Bartlett & Sons (Metal Workers), Limited—Capital, £20,000. Directors: G. F. E. and E. G. A. Bartlett. Subscriber: R. Keedwell, 18, Central Hill, London, S.E.19.

Buchanan & Wilson (London), Limited—Capital, £5,000. Importers and factors of tools and hardware, etc. Directors: A. R. Findlay and P. Logan, 17, Robertson Street, Glasgow.

Obituary

THE DEATH has occurred suddenly at Glasgow of Mr. Henry Peter Poulson, who was for 35 years associated with A. Reyrolle & Company, Limited, Hebburn-on-Tyne. He was aged 59 years.

MR. CECIL MICKLETHWAITE, who had been works manager of Firth-Vickers Stainless Steels, Limited, Tinsley, from the formation of the firm, died recently. Mr. Micklethwaite was for many years works manager of the Tinsley works of Thos. Firth, Limited. He continued in that capacity after the formation of Thos. Firth & John Brown, Limited, and on the formation of Firth-Vickers Stainless Steels, Limited.

PROF. HENRY JOHN SPOONER died last week at the age of 84. Head of the School of Engineering at the Regent Street Polytechnic for 40 years, he was educated privately and at the Royal School of Mines, and in 1879 began to lecture on engineering subjects to the staff and workers of the Royal Small Arms Factory, Enfield, and the Waltham Abbey Powder Mills. In 1882 he was appointed principal lecturer on mechanical science at the Polytechnic, and four years later became director and professor of mechanical and civil engineering—a position he retained until his retirement in 1922. He also practised as a consulting engineer.

MR. JAMES FERGUSON, chairman of Lane & Girvan, Limited, of Caledonia Stove and Iron Works, Bonnybridge, and a well-known figure in the Scottish light-castings industry, has died at his residence, Woodlea House, Bonnybridge. A native of Stranraer, Mr. Ferguson began his career with the Union Bank of Scotland. He resigned his post to enter the ironfoundry trade, and in 1910 he acquired Mr. Girvan's share of the partnership in Lane & Girvan, Limited. When the firm was formed into a private company in 1919 he was appointed managing director, and continued in that office until failing health brought about his retirement. On the death of the then chairman, the late Mr. William Ross Lane, Mr. Ferguson was appointed chairman of the company. Mr. Ferguson was a director of other industrial concerns in East Stirlingshire. Among the Bonnybridge social activities in which he took part, Mr. Ferguson was chairman of the district nursing association, and a past-President of the local silver band and of the bowling club.

Reports and Dividends

Hale & Hale (Tipton), Limited—Dividend of 7½ per cent.

Light Production Company, Limited—Interim dividend of 5 per cent. on the ordinary shares.

Alliance Aluminium Holdings, Limited—Net profit to June 30 last of £4,675, increasing the balance carried forward to £25,735.

J. Samuel White & Company, Limited—Final dividend on the ordinary shares of 8½ per cent., making 12½ per cent. for the year.

Anti-Attrition Metal Company, Limited—Profit for the year ended June 31, after tax, £24,695; final dividend of 8½ per cent., making 12½ per cent.

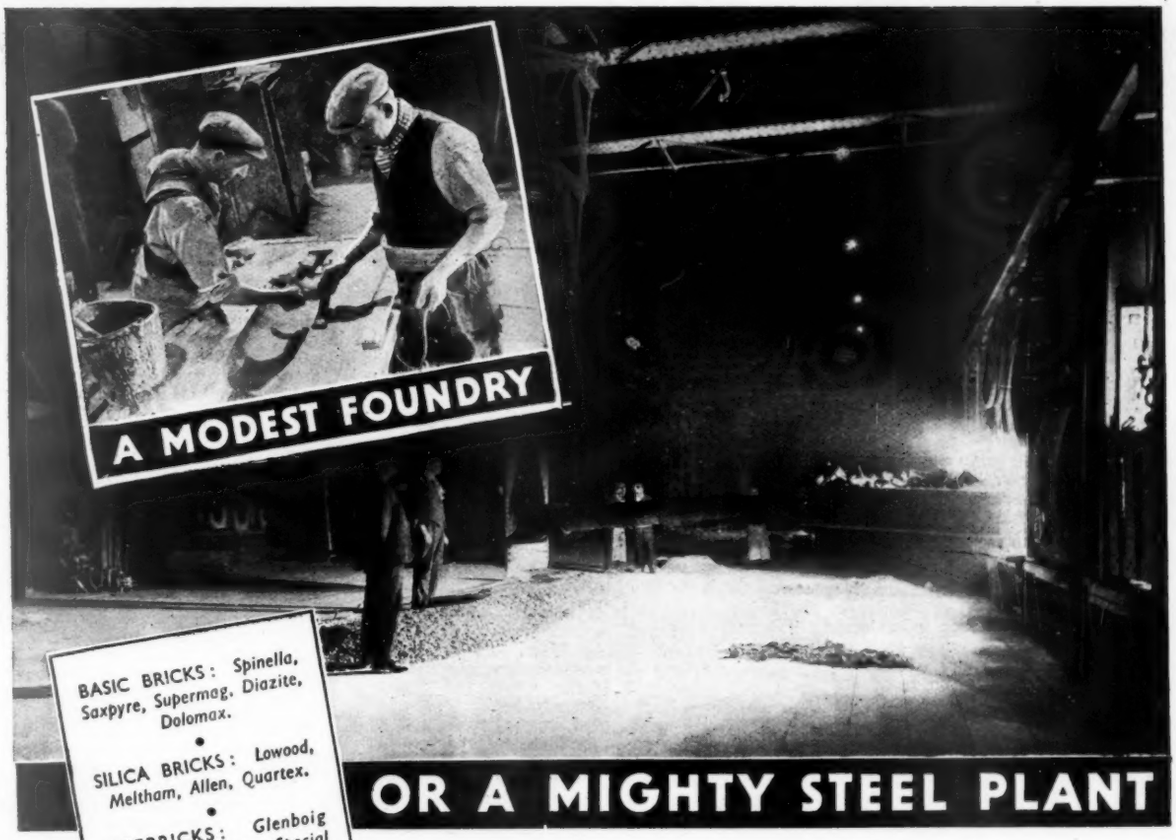
Drake & Gorham, Limited—Net profit for the year ended June 30 last, £1,960; brought in, £3,314; dividend of 2 per cent., £2,500; carried forward, £2,774.

Dunswart Iron & Steel Works, Limited—Net profit for the year to June 30, £33,780; brought in, £14,464; ordinary dividend of 14 per cent.; carried forward, £18,244.

Bertrams, Limited—Net profit for year ended September 30 last, £10,670; brought in, £1,437; dividend of 10 per cent.; to improvement reserve, £5,000; employees' provident fund, £2,000; carried forward, £2,520.

Marshall Sons & Company (Successors), Limited—Net profit for the year to September 30, after reserving £148,500 for taxes, £133,914; brought in, £23,296; contingencies, £50,000; final dividend of 10 per cent., making 13½ per cent. for the year; carried forward, £66,741.

Universal Grinding Wheel Company, Limited—Net profit to September 28 last, £75,118; brought in, £1,089; preference dividend, £20,000; 2 per cent. participating dividend on preference shares, £8,000; ordinary dividend of 10 per cent., tax free, £20,000; to reserve, £25,000; carried forward, £3,207.



BASIC BRICKS: Spinella, Saxpyre, Supermag, Diazite, Dolomax.

•

SILICA BRICKS: Lowood, Meltham, Allen, Quartex.

•

FIREBRICKS: Glenboig Special, Glenboig Special Crown, Glenboig, Glenboig Crown, Castlecary, Dykehead, Gem, White Carr, Stour, Hycone.

Alumantine, Hysilyn, Adamantine, Llangennech.

•

CEMENTS: Sintex, Durax, Pyrolyte.

•

INSULATION: Amberlite Bricks, Cement & Concrete.

•

SANDS: Moulding, Brick Facing, Silica, Glass.

•

PLASTICS: Durax, Rotaline, Plastic K-N, Glendoline, Ground Ganister.

•

SILLIMANITE: Tank Blocks, Bricks and Cements.

•

ACID-PROOF REFRACTORIES: Obsidianite, Losol.

•

. . . both bring their Refractory problems to General Refractories

BETWEEN users who exercise meticulous care and foresight in the selection of refractories and those who buy 'cheaply' regardless of quality—there are large numbers who acknowledge the value of a suitable refractory for their business, but lack the specialised knowledge, equipment and staff to compare refractory values. To them the General Refractories organisation has much to offer. For example, the "G.R." range of products will provide maximum service and efficiency for any stated purpose—"G.R." laboratories and staff are qualified to understand the problems of a user, to recommend the correct product and supply sound reasons for its selection. Thus users are assured of impartial and helpful service in selecting refractories. The continually increasing number of firms who make use of the "G.R." Technical Advisory Service is significant of the growing importance placed by users on the sound selection of refractories. With the changes imposed by war-time supplies of raw materials and production conditions, the vast resources of General Refractories are a definite assurance to users of maximum value-for-money.

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Raw Material Markets

Pressure for supplies of iron and steel is such that it has not been possible to arrange for plants to be idle for more than one day at Christmas or the New Year. Repairs to plant, too, which are often carried out at this time of the year, will be done with the minimum of lost production. Makers in most instances have arrears of orders to be made up on account of licences for the final quarter of the year, and there is certain to be quite a considerable carry-over in many cases. Nevertheless, consumers have been granted their allotments for the first period of the New Year and are losing no time in placing orders. The current situation does not warrant any relaxation in distribution arrangements, and users engaged either directly or indirectly on Government specifications will continue to be accorded priority certificates, with other consumers permitted smaller tonnages than they would like to receive.

Pig-Iron

MIDDLESBROUGH—Conditions on the iron and steel market here have shown little of the usual Christmas dullness, and consumers continue to press for the largest possible deliveries. Outputs are at high levels, but, even so, the demand cannot be satisfied in full. Production of foundry iron is still virtually suspended, and users are obtaining their requirements from Midland furnaces, which are able to despatch quite good tonnages. At one time, the Cleveland makers were easily able to meet local needs in addition to sending large supplies to Scotland and other destinations. Now, of course, Scottish buyers are drawing their iron from the Midlands. Local foundry-iron users are endeavouring to build up reserve stocks, but in this respect they are meeting with only moderate success, as consumption has increased considerably of late, while it is impossible to rely on deliveries coming through so regularly as formerly, although transport is better than had been expected in some quarters.

There has been a welcome improvement in the hematite situation during the past few weeks, due largely to the freer distribution of American iron, which has been imported under the auspices of the Iron and Steel Control. Imported iron is, of course, much more expensive than home-produced material, so that supplies are being distributed only to meet really urgent requirements. East Coast makers have little in the way of reserve supplies on hand, and further expansion in demands may be expected next year, so that the position is having to be watched very carefully.

LANCASHIRE—Holidays at Christmas among iron consumers will be so curtailed that there will be little, or no, respite in the pressure for deliveries. Lancashire foundries, on the whole, continue to be very busy, with the exception of light-castings makers and jobbing foundrymen, who are finding some difficulty in acquiring sufficient business to operate their plants to capacity. Most other sections of the foundry trade, however, are employed on work of national importance, and come within the priority category with regard to the allocation of iron. Derbyshire and other Midland producers are being called upon to meet a heavy demand, and it is satisfactory to report that supplies, generally speaking, are forthcoming on a good scale. Little change has occurred in the hematite position, with deliveries arriving rather spasmodically.

MIDLANDS—It is certain that deliveries of high-phosphorus iron to light-castings makers will be heavy in the New Year, as the Control authorities, in issuing licences for the first quarter of the year, have deemed it advisable to facilitate the building up of stocks at consuming works. Consumption, too, will be on an increased scale, as this trade is obtaining more and more business from Government departments. While supplies of high-phosphorus iron are coming through satisfactorily, low-phosphorus iron and hematite are less happily situated, although priority users are getting all they require for immediate needs. This, however, is only accomplished by the utilisation of appreciable tonnages from abroad. Heavy engineering foundries, machine-tool makers, etc., are the main users of these descriptions and, being largely engaged on Government contracts, are calling for substantial supplies.

SCOTLAND—Light-castings manufacturers are still only moderately well employed, and are able to purchase all the iron they need from the English Midlands on the basis of 126s. 9d., f.o.t. Falkirk, and 129s. 9d., f.o.t. Glasgow, less 5s. per ton rebate. Heavy engineering establishments and steelmakers are calling for heavy tonnages of iron, and it is unfortunate that shortage of railway wagons is holding back supplies to some extent. These concerns are well placed for raw materials, however, with perhaps the exception of hematite, which tends to be in short supply.

Coke

Deliveries of foundry coke are delayed at times, but little inconvenience is caused, most of the major buyers having considerable stocks on hand, for delivery to Birmingham and Black Country stations, the current quotation for Durham best coke is now 60s. 6d., minimum, but the higher price has not resulted in any slackening in the demand. Forward buying is still being carried on, producers being covered against further changes in price by a rise-and-fall clause.

Steel

The steel industry is so heavily committed that holidays at Christmas or the New Year, according to district, are being confined to a single day. Demands on the trade in connection with the war effort absorb the bulk of the output, and productions are fully booked for a considerable period ahead. Special steels, used in the production of munitions and other war products, are in increasing request and outputs are being enlarged where possible. In addition to other large consumers, shipbuilders are calling for heavy supplies of steel suitable for their requirements and, in view of the Government's large-scale programme for this industry, pressure from this source may be expected to increase further.

Scrap

Consumption of iron and steel scrap is maintained at a high level, and the introduction of increased prices has not made any difference whatsoever to demand. In any case, prices remain well below pig-iron quotations, so that there remains every inducement to consumers to utilise scrap to the fullest extent. Buyers are stocking supplies, taking advantage of the satisfactory supply position to provide for their future requirements. Transport difficulties are at times restricting deliveries, but users have not been seriously handicapped in this way.

Metals

A meeting of the International Tin Committee was held in London last week. No official statement was issued, but it is believed that the possibility of the renewal of the present international tin restriction scheme and the situation created by the contract made by a group of Bolivian tin producers to supply the United States authorities with ore for a new U.S. smelter were the main topics of discussion. All parties present were understood to be agreed on the desirability of continuing a restriction scheme in principle, but certain differences of view as to how continuance could best be effected were evident. The Malayan, Nigerian and Netherlands East Indies representatives apparently want to increase their standard tonnages when the present scheme lapses at the end of next year, but the Bolivian producers were desirous of preventing this. The general opinion regarding the Bolivian contract with the U.S. authorities is believed to have been that it constituted in effect a subsidy for the Bolivian industry, since it provided for the acquisition of low-grade Bolivian tin which had previously been unsaleable.

Further references to the burden of the 100 per cent. Excess Profits Tax and its effect on tin-mining companies have been made at company meetings. Mr. H. B. Ward, chairman of the Sione Tin (F.M.S.) concern, said he would like to support the representations made to the Government by the tin-mining industry calling attention to the inequity in the case of the tin companies of taking 100 per cent. excess profits without allowing any charge against profits for the cost of its tin-bearing land exhausted in earning such excess profits. The result of this was that the company made an actual direct loss to the extent of the cost of the land, in addition to depleting its reserves of ore and shortening the life of the mine.

Mr. J. H. Rich, who read a speech prepared by Mr. C. V. Thomas (chairman) at the meeting of Ayer Hitam Tin Dredging, Limited, said that although he would like to say something about E.P.T., he would make it clear that his remarks were not intended to convey any reluctance to shoulder a fair share of the financial burden that we all had to bear. Mines were wasting assets, and Malayan tin mines had a comparatively short life. In addition to these mines being wasting assets, their production during the past nine years had been compulsorily restricted, which made it impossible to arrive at a correct figure representing standard profit as the basis of Excess Profits Tax. The subject of Malayan production in connection with Excess Profits Tax had been further involved by virtue of the agreement between the Metals Reserve Company of the U.S.A. and the International Tin Committee with the consent and approval of the British Government, with the object of creating a reserve stock of tin for a friendly but foreign Power. To implement this agreement Malayan producers had been requested by the Malayan Government to produce to the limit of their capacity, not, it would be noted, to satisfy consumptive demand, but to build up a stock. The increased profit, however, from this maximum production was referred to a standard profit based on a period when production was compulsorily restricted, and was entirely absorbed by Excess Profits Tax. In effect the step the British registered companies were asked to take amounted to the confiscation of a large proportion of their ore reserves and functioned as a capital levy. That, however, was not all, for at some future date, when probably Excess Profits Tax had been removed, the same companies which, at the Government's request, assisted to build up this reserve and were deprived of the resulting profits by taxation, would be compelled to work at a loss whilst this stock was in process of liquidation. A possible way in which the Government could be assured of the maximum available contribution from company revenue, and at the same time leave the company with some substantial provision for the inevitably difficult post-war period, would be that a certain reasonable percentage of the excess profit would be absorbed by taxation, and the balance of the 100 per cent. would be held in blocked accounts until the close of the war.

While business on the London tin market has again been on the quiet side, advices from the other side of the Atlantic indicate that buying there has been more active, with the U.S. Navy Department in the market for fairly important supplies.

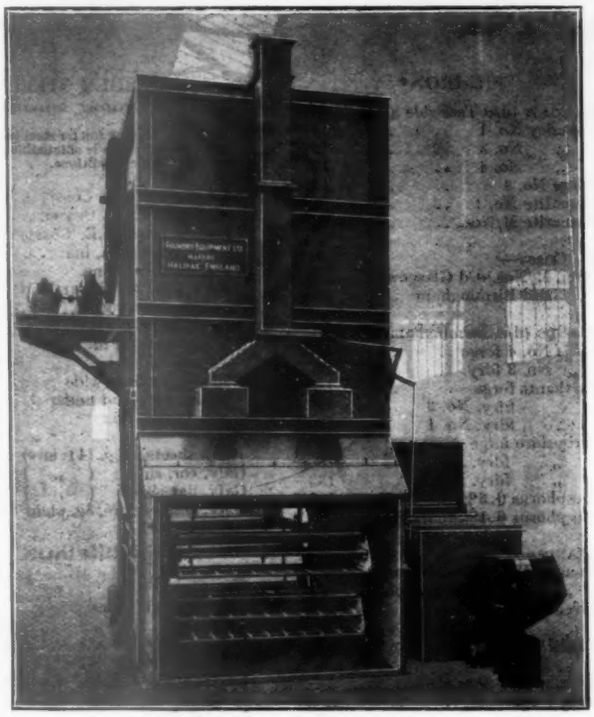
London Metal Exchange tin prices this week have been as follow:—

Cash—Wednesday, £257 5s. to £257 10s.; Thursday, £257 to £257 5s.; Friday, £257 to £257 5s.; Monday, £257 5s. to £257 10s.

Three Months—Wednesday, £260 5s. to £260 10s.; Thursday, £259 15s. to £260; Friday, £259 15s. to £260; Monday, £260 to £260 5s.

The copper position changes little from week to week, the bulk of the supplies being accounted for by war contracts. Consumption in the United States is at a high level, and it is believed that the Government will shortly negotiate for supplies of foreign metal, as requirements are ahead of production. Of American copper exports in October, Japan took 24,835 tons, against 9,269 in September; United Kingdom, 1,349 (1,200); China, 766 (355); Brazil, 291 (185); India, 126 (50); and Greece, 180 tons (nil).

Only comparatively meagre tonnages of spelter continue to be available for ordinary domestic users after the needs of firms engaged on war contracts have been met. On the other hand, lead is in ample supply for all purposes, largely due to supplies which hitherto were utilised in the manufacture of housebuilding requisites being released for other needs.



CONTINUOUS CORE STOVES

TREMENDOUS PRODUCTION

Illustration shows stove, with Automatic Stoker.
Also made for ordinary hand coke firing.

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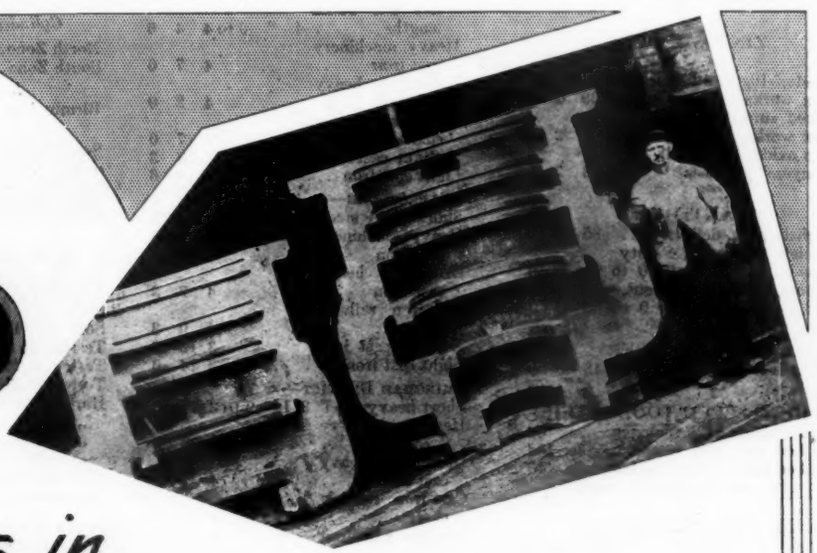

ON ADMIRALTY, WAR OFFICE, AIR MINISTRY, LLOYDS, AND OTHER APPROVED LISTS.

STEEL CASTINGS

From a few ounces up to **52 TONS**

FOR ALL INDUSTRIES

JAMES BRIDGE STEEL WORKS near WEDNESBURY

PHONE DARLASTON 225 (3 lines)
GRAMS STEEL DARLASTON

RAW MATERIALS—PRICE LIST

Tuesday, December 24, 1940

COPPER*

	£	s.	d.
Electrolytic	62	0	0
High-grade fire-refined	61	10	0
Fire-refined of not less than 99.7 per cent.	61	0	0
Do., do., 99.2 per cent.	60	10	0
Black hot-rolled wire rods	65	10	0

TIN

(Closing prices December 23)

Standard cash	257	5	0
Three months	260	0	0
Settlement	257	5	0
Official average Cash, Nov.	258	7	6
Do. Three Months, Nov.	260	5	1⅜
Do. Settlement, Nov.	258	6	5½

SPELTER*

G.O.B. (foreign) (duty paid)	25	15	0
Do. (domestic)	26	10	0
"Prime Western"	26	10	0
Refined and electrolytic	27	5	0
Not less than 99.99 per cent.	28	15	0

LEAD*

Good soft pig lead (foreign) (duty paid)	25	0	0
Do., do., (Empire and domestic)	25	0	0
English	26	10	0
Sheets, home	34	10	0
Do. export, f.o.b.	30	0	0
Pipes, home	34	0	0
Do. export, f.o.b.	30	10	0
Tea lead (nom.)		—	

ALUMINIUM

Ingots	£110
Wire, 10g.	nom.
Sheets	nom.
Circles, 20/24g.	nom.

ZINC SHEETS, etc.

	£	s.	d.
Sheets, 10g. and thicker, ex works	39	2	6
Rolled zinc (boiler plates), ex works	37	2	6
Zinc oxide (Red Seal), d/d buyers' premises	28	7	6

ANTIMONY

English, 99%, delivered	85	0	0
Foreign Regulus, duty paid	88 0 0 to 91	0	0
Chinese, prompt shipment, c.i.f.	76 0 0 to 80	0	0

QUICKSILVER

Quicksilver, ex-w'hse London	48	0	0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 3s. 0d.
Finished bars, 18% tungsten 3s. 10d.
Finished bars, 22% tungsten 4s. 4d.
Per lb. d/d buyers' works.

NICKEL SILVER, etc.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
to 10g.	1/6½ to 2/1½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/5½ upwards.

* Maximum prices per long ton delivered to buyers' premises.

FERRO-ALLOYS AND STEEL-MAKING METALS

(all prices nominal.)

	£	s.	d.
Ferro-silicon (5-ton lots)—			
25%	18	10	0
45%	23	10	0
75%	36	10	0
Ferro-vanadium—			
35/50%	15/6 lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free	6/- lb. Mo.		
Ferro-titanium—			
20/25% carbon-free	1/9 lb.		
Ferro-tungsten—			
80/85%	5/1 lb.		
Tungsten metal powder—			
98/99%	5/2½ lb.		
Ferro-chrome—			
2/4% car.	—		
4/6% car.	47	0	0
6/8% car.	47	0	0
8/10% car.	—		
Ferro-chrome—			
Max. 2% car.	—		
Max. 1% car.	—		
Max. 0.5% car.	—		
70% carbon-free	—		
Nickel—99.5/100%	£190 to £195		
"F" nickel shot	175	0	0
Ferro-cobalt, 98/99%	8/9 lb.		
Metallic chromium—			
96/98%	3/9 lb.		
Ferro-manganese—			
76/80% loose	18	10	0
76/80% packed	20	0	0
Metallic manganese—			
94/96% carbon-free	1/9 lb.		

Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.

SCRAP*

	£	s.	d.	£	s.	d.
SOUTH WALES—						
Short heavy steel, not ex. 24-in. lengths	4	2	0	to 4	4	6
Heavy machinery cast iron				4	7	0
Ordinary heavy cast iron				4	2	0
Cast-iron railway chairs				4	7	0
Medium cast iron				3	18	3
Light cast iron				3	13	6
MIDDLESBROUGH—						
Short heavy steel	3	19	9	to 4	2	3
Heavy machinery cast iron				4	11	9
Ordinary heavy cast iron				4	9	3
Cast-iron railway chairs				4	9	3
Medium cast iron				3	19	6
Light cast iron				3	14	6
BIRMINGHAM DISTRICT—						
Short heavy steel	3	14	9	to 3	17	3
Heavy machinery cast iron				4	12	3
Ordinary heavy cast iron				4	7	6
Cast-iron railway chairs				4	7	6
Medium cast iron				4	0	3
Light cast iron				3	15	3
SCOTLAND—						
Short heavy steel	3	19	6	to 4	2	0
Heavy machinery cast iron				4	14	3
Ordinary heavy cast iron				4	9	3
Cast-iron railway chairs				4	14	3
Medium cast iron				3	17	3
Light cast iron				3	12	3

* Delivered free to consumers' works in England and Wales. For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less. All prices: Plus 3½ per cent. dealers' remuneration: 50 tons and upwards over three months 2s. 6d. extra.

PIG-IRON*

N.E. COAST (d/d Tees-side area)—	
Foundry No. 1	131/-
„ No. 3	128/-
„ No. 4	127/-
Forge No. 4	127/-
Hematite No. 1	138/6
Hematite M/Nos.	138/-
N.W. COAST—	
Hem. M/Nos. d/d Glasgow	138/6
„ d/d Birmingham	150/-
MIDLANDS (d/d Birmingham dist.)—	
Staffs No. 4 forge	129/-
„ No. 3 fdry.	130/-
Northants forge	126/6
„ fdry. No. 3	127/6
„ fdry. No. 1	130/6
Derbyshire forge	129/-
„ fdry. No. 3	130/-
„ fdry. No. 1	133/-
Phosphorus 0.5% to 0.75%	137/6
Phosphorus 0.1% to 0.5%	140/6
SCOTLAND—	
Foundry No. 1, Grangemouth	127/3
„ No. 3, Grangemouth	124/9
Cleveland No. 3, Glasgow	131/-
„ „ Falkirk	128/-
Scottish hem. M/Nos. d/d	138/6
SHEFFIELD (d/d district)—	
Derby forge	126/6
„ fdry. No. 3	127/6
Lincs forge	126/6
„ fdry. No. 3	127/6
W.C. hematite	144/-
LANCASHIRE (d/d eq. Man.)—	
Derby fdry. No. 3	133/-
Staffs fdry. No. 3	133/-
Northants fdry. No. 3	131/6
Cleveland fdry. No. 3	133/-
Cylinder and Refined Irons	
North Zone	174/-
South Zone	176/6
Refined Malleable	
Birmingham and S. Staffs	171/6
Cold Blast	
South Staffs	220/6

* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent, are subject to a rebate of 5s. per ton under certain conditions.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.

	£	s.	d.
BASIC:			
Soft, u.t., 100-ton lots	12	5	0
Tested, up to 0.25% C.	12	10	0
Tested, 0.25 to 0.33% C.	12	12	6
Tested, 0.33 to 0.41% C.	12	15	0
Hard (0.42 to 0.60% C.)	13	17	6
„ (0.61 to 0.85% C.)	14	7	6
„ (0.86 to 0.99% C.)	14	17	6
„ (1% C. and up)	15	7	6
Silico-manganese	16	5	0
Free-cutting	14	10	0
SIEMENS MARTIN ACID			
Up to 0.25% C.	15	15	0
Case-hardening	16	12	6
Silico-manganese	16	5	0

Billets, Blooms and Slabs for Forging and Stamping.

Basic soft, up to 0.25% C.	13	17	6
Basic hard, 0.41 to 0.60% C.	14	10	0
Acid, up to 0.25% C.	16	5	0

Other Semi-products, etc.

Tin bars	12	2	6
Sheet bars	12	2	6
*Wire rods, soft basic	17	7	6
„ hard basic	21	2	6
„ free-cutting	20	2	6
„ acid	24	13	6

* Subject to rebate

FINISHED STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.]

	£	s.	d.
Plates, ship (N.E. Coast)	16	3	0
Boiler plts. (N.E. Coast)	17	0	6
Chequer plts. (N.E. Coast)	17	13	0
Angles, over 4 un. ins.	15	8	0
Tees, over 4 un. ins.	16	8	0
Joists, 3 in. × 3 in. and up	15	8	0
Rounds and squares, 3 in. to 5½ in.	16	8	0
Rounds under 3 in. to ½ in. (untested)	17	12	0
Flats—over 5 in. wide	15	13	0
„ 5 in. wide and under	17	12	0
Rails, heavy, f.o.t.	14	10	6
Hoops	18	7	0
Black sheets, 24 g. (4 t. lots)	22	15	0
Galv. cor. shts. („)	26	2	6
Galv. flat shts. („)	26	12	6
Galv. fencing wire, 8g. plain	26	17	6

FINISHED IRON

	£	s.	d.
CROWN IRON:			
England and Wales	15	12	6
Scotland	15	12	6
Ireland, f.o.q.	16	6	0
No. 3 BARS:			
England and Wales	12	10	0
Scotland	13	12	6
Ireland, f.o.q.	13	2	6
No. 4 BARS:			
England and Wales	13	0	0
Scotland	13	17	6
Ireland, f.o.q.	13	12	6
STRIP:			
England and Wales	17	0	0
STAFFS MARKED BARS, f.o.t.	—		

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated, November 14, 1940.

	Dols.
No. 2 foundry, Phila.	24.84
No. 2 foundry, Valley	23.00
No. 2 foundry, Birm.	19.38
Basic, Valley	22.50
Malleable, Valley	23.00
Grey forge, Valley	22.50
Ferro-mang., seaboard	120.00
O.-h. rails, h'y, at mill	40.00
Billets	34.00
Sheet bars	34.00
	Cents
Iron bars, Chicago	2.25
Steel bars	2.15
Tank plates	2.10
Beams, etc.	2.10
Wire rods	2.00
Skelp, grooved steel	1.90
Steel strip	2.10
Steel sheets	2.10
Sheets, galv., 24 g.	3.50
Wire nails	2.55
Plain wire	2.60
Tinplates, 100-lb. box	$5.00

COKE (at ovens)

(nominal)

Welsh foundry	46/6 to 48/-
„ furnace	35/6 to 37/-
Durham foundry	42/-
„ furnace	35/6
Scottish foundry	45/- to 50/-
„ furnace	35/6

TINPLATES

(f.o.b Bristol Channel ports)

I.C. cokes	20 × 14 per box	30/9 to 32/-
„	28 × 20 „	61/6 to 64/-
„	20 × 10 „	44/3 to 44/9
„	18¾ × 14 „	32/- to 32/6
C.W.	20 × 14 „	27/9 to 28/9
„	28 × 20 „	55/6 to 57/6
„	20 × 10 „	42/3 to 42/9
„	18¾ × 14 „	30/- to 30/6

NON-FERROUS SCRAP

(Official Maximum Prices, per ton ex Works.)

	£	s.	d.
Bright untinned copper wire, in crucible form or in hanks	57	10	0
No. 1 copper wire	57	0	0
No. 2 copper wire	55	10	0
Copper firebox plates, cut up	57	10	0
Clear untinned copper, cut up	56	10	0
Braziery copper	53	10	0
Q.F. process and shell-case brass, 70/30 quality, free from primers	49	0	0
Clean fired 303 S.A. cartridge cases	47	0	0
70/30 turnings, clean and baled	43	0	0
Brass swarf, clean, free from iron and commercially dry	34	10	0
New brass rod ends, 60/40 quality	38	10	0
Hot stampings and fuse metal, 60/40 quality	38	10	0
Admiralty gunmetal, 88-10-2, containing not more than ¼ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin	72	0	0

NEW BRASS TUBES, etc.

	Per lb.
Solid drawn tubes	13½d.
Brazed tubes	15½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	8½d.
Sheets to 10 w.g.	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods	8½d.

COPPER TUBES, etc.

Solid drawn tubes	14½d.
Brazed tubes	14½d.
Wire	9½d.

PHOSPHOR BRONZE

	Per lb. basis
Strip	13½d.
Sheet to 10 w.g.	13½d.
Wire	15½d.
Rods	15½d.
Tubes	20½d.
Castings	17d.

Delivery 3 cwt. free.
10% phos. cop. £35 above B.S.
15% phos. cop. £40 above B.S.
Phosphor tin (5%) £40 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1903	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 2 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 3½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 6	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	7 15 11½	
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 8½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	13 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	10 5 0	10 17 6	21 0 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 3	10 1 7	10 6 8
1930	10 2 9	10 3 5½	10 3 9	10 3 6	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	9 10 11	9 6 9	9 5 0	9 7 0	9 7 9½	9 8 9	9 5 9	9 5 6	9 9 6	9 9 4½
1932	9 5 0	9 2 6	8 18 6	8 17 6	8 16 6½	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 17 10
1933	8 10 0	8 10 0	8 10 0	8 8 9	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 6 0	8 7 6	8 6 10½
1934	8 8 1½	8 10 7½	8 16 6	8 17 6	8 6 3	8 6 3	8 5 7½	8 5 0	8 5 0	8 5 0	9 5 0	9 5 0	8 11 0
1935	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0
1936	9 5 0	9 5 0	9 5 0	9 5 0	9 8 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 18 1	9 12 7½
1937	10 0 6	10 0 6	10 0 6	10 0 6	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 5 6
1938	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0
1939	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	12 8 0	12 8 0	11 11 4
1940	12 8 0	13 8 0	13 8 0	13 8 0	13 8 0	13 8 0	15 0 6	15 0 6	15 0 6	15 0 6	17 0 6	17 0 6	14 9 3

WILLIAM JACKS & COMPANY LIMITED
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS
COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY LIMITED
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2
ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

TO ENGINEERS AND IRONFOUNDERS.—Expert advice given to ironfounders who are in difficulties owing to shortage of low-phosphorus pig-irons. 30 years' experience in the mixing of irons. Analyses and mechanical tests accurately undertaken.—Apply to A. R. SCOTT, Metallurgist, New Whittington, Chesterfield.

FOUNDRY Foreman wanted by old-established engineering company in Yorkshire. Well-equipped ironfoundry, loam, dry and green sand, castings up to 12 tons.—State age, qualifications and salary required to Box 590, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

SUPERINTENDENT of Employment for large Engineering Works in Hertfordshire. Duties would include supervision of labour engagement; also training schemes for apprentices and trainees.—State age, experience and salary required to Box 588, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

EMPLOYMENT REGISTER.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

ASSISTANT FOREMAN with sound and varied experience on light castings, machine tools, etc., desires position as foreman. Exceptionally good technical training, successful engineering student. Experienced in repetition light castings. Highest recommendations. (392)

MACHINERY

FOR SALE.—One Junior Motive Type Sand-slinger, built by the Foundry Plant & Machinery, Ltd., and only recently put into work. Travelling type with 7-tons sand bin with 12-ft. radius arm. The machine is complete and in first-class condition. Can be seen by appointment.—SIR JAMES FARMER NORTON & CO., LTD., Adelphi Iron Works, Salford 3, Manchester.

MACHINERY—*Continued*

PNEUMATIC MOULDING MACHINES

Macdonald Jolter, table 72 in. by 54 in.

Tabor ditto, table 27 in. by 20 in.

Tabor 21 in. by 16 in. squeeze.

Zimmerman Type R.P.W. 2 Jolt Squeeze turnover, table 36 in. by 20 in.

Mumford Type (Jackman) Swing Headpress, 13 in. by 15 in. and 14 in. by 16 in.

Mumford Pneumatic Core Jolters having 15-in. by 20-in. and 12-in. by 12-in. tables.

Britannia No. 1 "Coventry" Pneumatic Turnover Jarr Ram, table 30 in. by 28 in.

50 Air Compressors; 500 Electric Motors, Dynamos, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD, LANGLEY,
Nr. Birmingham.
'Phone: Broadwell 1359.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hour; New Worm-geared Ladles, 4-tons, 2-tons, 30-cwts., 20-cwts., 15-cwts. and 10-cwts. capacity; also Osborn Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester, 12.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & CO. LTD., Station Works, Ecclesfield, Sheffield.

THOS. W. WARD, LTD.

No. 16 "Brown & Sharpe" PLAIN GRINDING MACHINE, 12-in. by 72-in. capacity; 2 wheel speeds; 12 table speeds; 8 work speeds; 18-in. dia. wheel.

"Modern" PLAIN GRINDING MACHINE, 8-in. by 30-in. capacity; maximum swing, 9 in.; admit 14-in. by 2-in. face wheel; self-contained countershaft drive; 10 h.p. required to operate.

Write for "Albion" Catalogue.

ALBION WORKS, SHEFFIELD
'Grams: "Forward." 'Phone: 26311 (15 lines).

MISCELLANEOUS

WANTED FOR OUR OWN WORKS.

ZINC ALLOY, ZINC DIE-CAST
Scrap, Dross and Turnings.
PURE CADMIUM, CADMIUM ALLOY
Scrap Dross and Turnings.
LEAD BRONZE
Scrap Dross and Turnings.
ALUMINIUM AND ALLOYS
Dross, Filings and Sawings.

Offers with samples to OAKLAND METAL COMPANY, LIMITED, Oakland Works, Oaklands Road, London, N.W.2.

MISCELLANEOUS—*Continued*

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

'Phone: 22877 SLOUGH

TWO NEW Core blowers for bombs.

36" Cupola by Jackman.

50" Cupola by Jackman.

2 Morgan 250 lbs. Tilting Furnaces Oilfired.

No. 1 August Sandmixer.

No. 2 August Type Mixer.

NEW PIT FURNACES 150 lbs. capacity, oil or coke fired. £35 each.

NEW SHOT BLAST CABINET PLANTS with motor driven Exhaust Fans, complete, all sizes. Prompt delivery.

Modern 60" Jackman Sandblast Table.

ALEX. HAMMOND, *Foundry Machinery Merchants.*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY.

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-half. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d a year to you. Send Peter and his handicapped pals 3d for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,
SCHOOL FOR THE BLIND
(Founded 1838)
SWISS COTTAGE, LONDON, N.W.3

CORE OVEN.

THE "PORTWAY"
PORTABLE CORE OVENS
For Gas or Fuel.

TESTIMONIAL.

The Letchworth Casting Co. Ltd.,
Birds Hill, LETCHWORTH, Herts.
15th May, 1939.

Dear Sirs,

With reference to the Portway Core Stove installed for us in 1937, we are pleased to state that this is very efficient and satisfactory in every way. The consumption of fuel is very low and consequently the stove is an economical unit,

We shall always be happy to recommend its use to our friends.

Yours faithfully, Signed . . . H. G. Barrett,
LETCHWORTH CASTING CO. LTD.

Makers—
C. PORTWAY & SON, LTD. Tortoise Stove & Portway Portable Oven Works, **HALSTEAD, ESSEX.**

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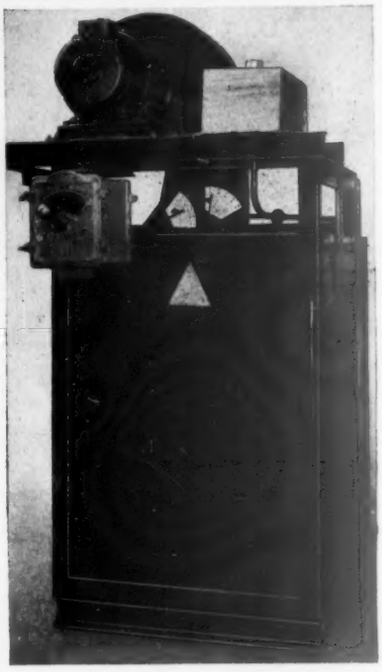

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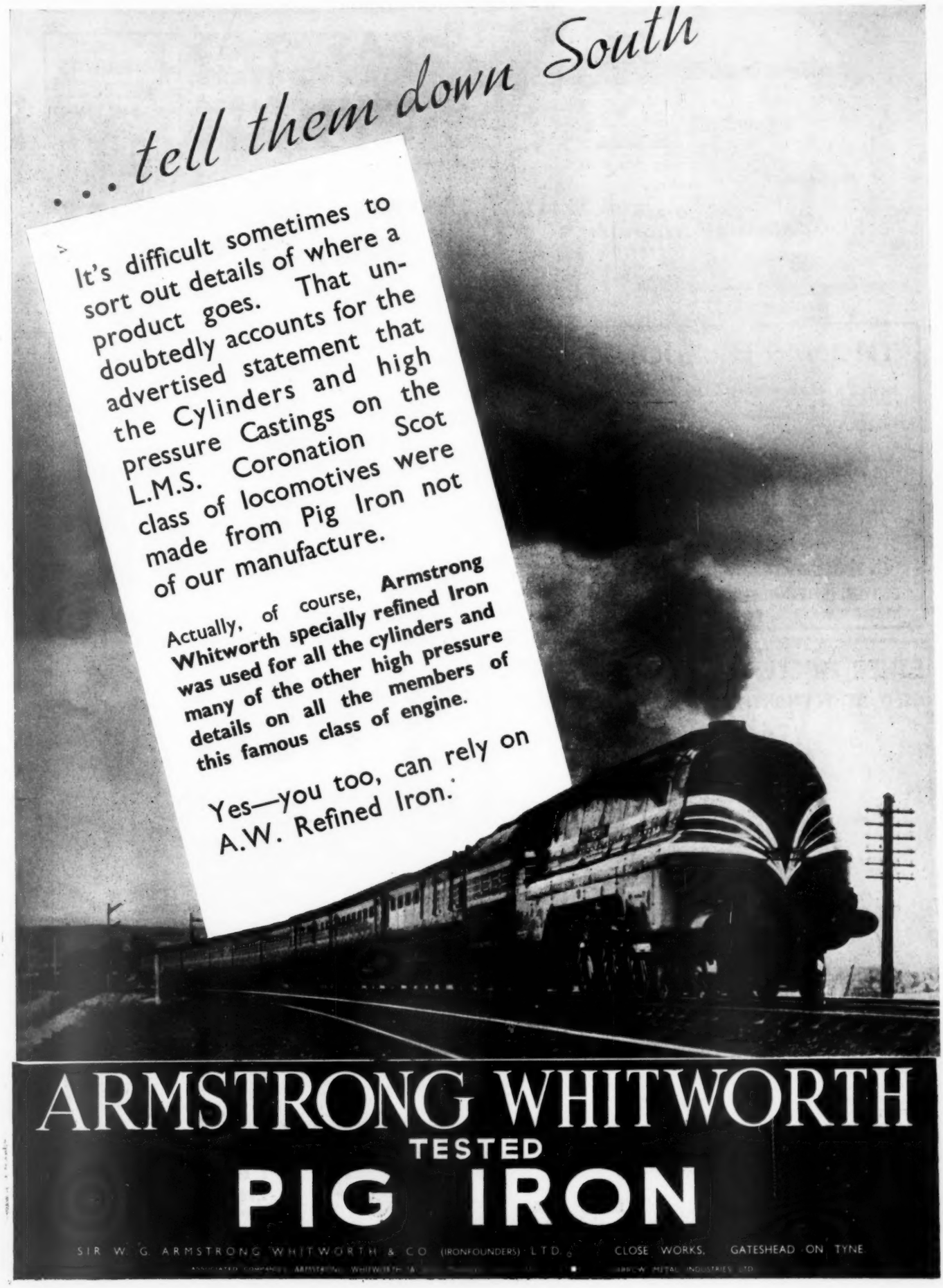
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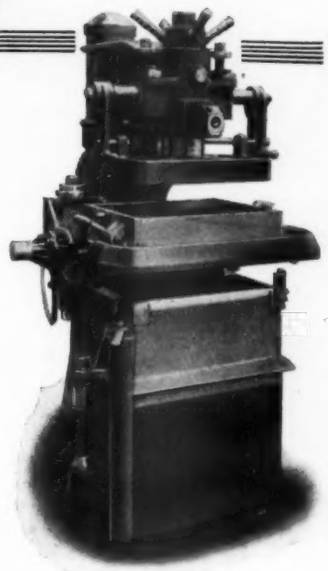

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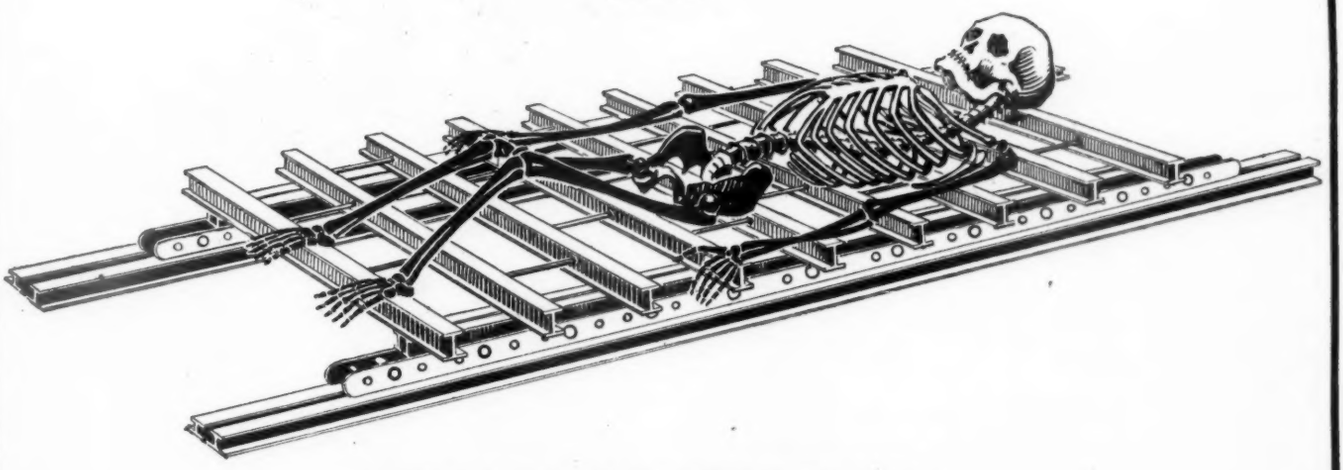

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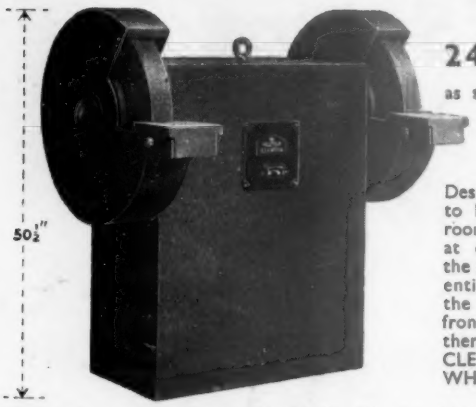

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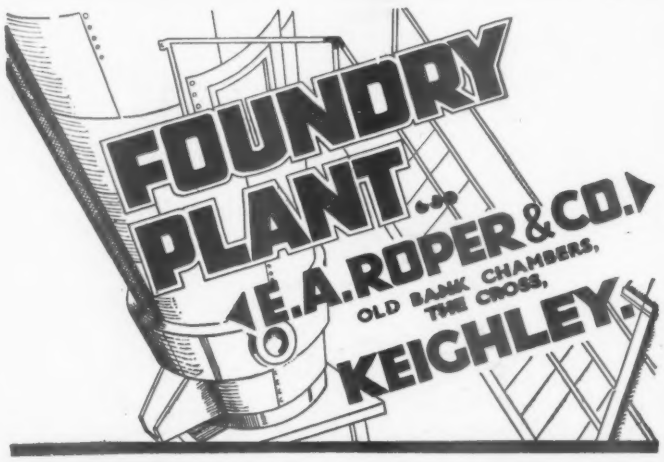

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